NatureServe
A Network Connecting Science With Conservation

CENTRAL BASIN AND RANGE
RAPID ECOREGIONAL ASSESSMENT
FINAL MEMORANDUM I-1-C

Prepared for:
Department of the Interior
Bureau of Land Management
Rapid Ecoregional Assessments

Submission Date: August 27, 2010

Submitted to:
Department of the Interior
Bureau of Land Management, BC-662
Building 50, Denver Federal Center
P.O. Box 25047
Denver, Colorado 80225-0047
Attn: Craig Goodwin, Ecoregional Assessment Project Manager

Submitted by:
NatureServe
1101 Wilson Boulevard, 15th Floor
Arlington, Virginia 22209

Patrick Crist, Principal Investigator

Contents

Figures

Tables

Executive Summary

Rapid Ecoregional Assessments (REAs) are the first step in the Bureau's Landscape Approach. REAs are intended to synthesize existing knowledge and information applicable to all lands and waters within the ecoregion. This synthesis aims to inform subsequent decision making, implementation, and monitoring by BLM and partners within the ecoregion, and should interact with ongoing scientific research as a foundation for science-based land management. REAs are organized into a series of phases and component tasks. Phase 1 includes tasks that clarify the scope, expected data and modeling approaches to be used, and culminating in a detailed workplan for the analysis. Phase 2 completes the preparation of data, conducts agreed-upon analyses, and documents assessment results. This memorandum summarizes the work, decisions, and remaining issues to be resolved for Task 1, Phase 1 for the Central Basin and Range Ecoregion. Here we initiate the assessment to scope the overall effort, clarify key management questions to be answered, define the ecoregion, establish our criteria and approach for treating selecting and treating focal Conservation Elements, and determine the relevant Change Agents that will be addressed. This memorandum is the final draft (1-c) which incorporates comments on the first draft (Memorandum 1-a) provided at AMT Workshop 1 or submitted separately to BLM.

Task 1 Objectives

The objectives of Task 1 were:

1. Define the assessment region as the ecoregion and a buffer
2. Create a conceptual ecoregion model
3. Review and assess proposed management questions
4. Review and assess proposed conservation elements (CEs)
5. Review and assess proposed change agents (CAs)
6. Conduct a review of recommendations with the AMT
7. Complete initial recommendations to feed into Task 2 data assessment

Ecological Models

Conceptual ecological models assist with organizing current knowledge and communicating key assumptions about the environmental controls and dynamics that characterize a given area. The purpose of our ecoregional model is to express key assumptions about regional landscape patterns and processes that will inform our selection and analysis of conservation elements and change agents; and provide a framework for a series of component models for the ecoregion. Here we adapted existing model concepts highlighting climatic regimes and regional physiographic pattern. These overarching controls vary according to differences in solar radiation and air density and seasonal temperature regimes along longitudinal, latitudinal, and elevational gradients. Seasonal precipitation regimes vary along these gradients but also with rain-shadow effects. Combined, these controlling regimes set up regional patterns in wind, dry/wet atmospheric deposition, and air quality.

We then defined the major model components, acknowledging the central role of water in this cool desert ecoregion, we first distinguish upland 'dry-land' ecosystems driven generally by water scarcity from aquatic, riparian, and wetland ecosystems driven by water flow regimes. Again, given the pervasive influence of interacting climate and physiography, we distinguish the major model components into "Montane Dry Land" vs. "Basin Dry Land" and "Montane Wet" vs. "Basin Wet" systems. The dry land systems include natural drivers of soil moisture infiltration, erosion, soil organic matter accumulation, and natural disturbance dynamics such as windthrow and wildfire. These vary considerably between higher, cooler montane settings and warmer basin settings. The Montane Dry Land System will be further characterized (in Phase 1 Task 3) by a series of submodels that encompass alpine uplands, subalpine woodlands and forests, montane mixed conifer forests, pinyon-juniper woodlands, and montane shrublands (including montane sagebrush and chaparrals), as well as montane cliff and canyon environments. The Basin Dry Land System model will be further subdivided by a series of submodels for semi-desert shrublands, shrub steppe, desert scrub, desert cliff and outcrops, and sand dunes. Likewise, "wet" systems, including streams, larger rivers, lakes, springs, desert sinks, wetlands, and riparian environments, are strongly driven by seasonal water flow regimes and the relative influence of surface to groundwater dynamics. The Montane Wet System will be subdivided into submodels for alpine-to-montane lakes, streams, wetlands, and riparian communities. The Basin Wet System will be subdivided into submodels for low-elevation lakes, streams, desert springs, marshes, floodplain and riparian communities, desert washes, playas and greasewood flats.

The human dimension enters as a distinct component model, as socioeconomic and demographic drivers of change in land and water use and policy overlay on other model components. Natural drivers such as herbivory, wildfire, and biological soil crust processes may be directly altered through exotic ungulate grazing regimes and altered fire regimes in the dry land systems. Predator/prey dynamics are influenced by human/wildlife conflicts, hunting, exotic ungulate (e.g. horse/burro) congregation, and collecting. Land conversion and introduction of invasive plant species closely follow human land use patterns for settlements, energy development (e.g., mining, oil/gas, solar, wind farms, geothermal), irrigated agriculture, or transportation/communication infrastructure. Within wet systems, the human dimension is expressed through water withdrawals or diversions, water pollution, wetland alterations through hydrologic alteration, conversion, exotic ungulate trampling, or introduction of invasive species.

Management Questions

Individual Management Questions (MQs) address specific needs for information that will ultimately inform BLM's management actions on the landscape. Individual MQs are driven by an iterative dialog among three aspects of land management planning: (1) an understanding of the ecological systems and social context, (2) the entities that are of concern and are under management, and (3) the processes or activities that can effect change in the managed landscape.

A goal of Task 1 is to develop a set of comprehensive and informative MQs. BLM provided a preliminary set of 70 MQs in 19 groups. We refined these preliminary MQs using seven criteria.

(1) Is each MQ stated in a clear and focused way that can be commonly understood by all participants?

(2) Is each MQ matched to and answerable with available data and planned analyses?

(3) Are there important issues or questions missing from the list of MQs?

(4) Are there MQs that are extraneous, duplicative, or determined to be of lesser importance?

(5) Do any MQs suggest Conservation Elements or Change Agents that are missing from the target lists (under development) for the project?

(6) Are all Conservation Elements and Change Agents addressed in at least one MQ?

(7) Are each of the MQs clearly incorporated somewhere into the ecological models under development for the project?

Applying these criteria led to adjustments to the text and phrasing of the preliminary MQs and a small number of additions and deletions. Our complete set of MQs is based on the groundwork described in Memo I-1-a and the discussions of AMT1. The resulting list includes 81 MQs in 20 categories, cross-referenced with CEs and/or CAs.

Many important MQs are expressed as simple "Where" questions. They require minimal formal analysis and are typically geospatial descriptions of the locations of CEs, the presence of CAs, features such as aquatic resources, and other data entities or processes of interest. A useful land management analysis can result from overlaying the results of "Where" questions to identify areas of potential management concern. Such maps of potential effects do not demonstrate an existing impact or problem, but they can (1) help prioritize locations that warrant further investigation and (2) identify opportunities for high impact management action. Other MQs may be based on more complicated development of indices or projections into the future.

Collectively, the MQs are meant to create a picture of the overall health and integrity of the ecoregion, the threats to it, and point to locations of potentially effective and sustaining high-impact management actions.

Conservation Elements

Conservation Elements: A first step in most natural resource assessments is the identification of the features to be assessed. For Rapid Ecoregional Assessments, we refer to these as "conservation elements" (CEs). Key to selection of conservation elements is establishing clarity of purpose. ***What do we need to learn from the assessment?*** For this REA, we propose a two-track focus for assessment. One track focuses on the ecological resources of the ecoregion, supporting regional biodiversity and providing the major ecosystem services. This focus emphasizes assessment of ecological integrity of landscapes and waterscapes. These define our **Core Conservation Elements.** The second track augments the first by including additional resource values of interest to agencies and stakeholders. These define our **Desired Conservation Elements.**

To define our core conservation elements we propose a "coarse filter/fine filter" approach, used extensively for regional and local landscape assessments since the 1970s. 'Coarse-filter' focal ecological resources typically include all of the major ecosystem types within the assessment landscape. We then pose the question; if all major ecosystem types are managed and conserved in sufficient area and landscape configuration, which of the 'vulnerable' species will have sufficient habitat "swept along"? Those species that are ***not*** adequately addressed through management of the coarse-filter elements are included as additional foci for assessment – the "fine filter." This approach therefore sets up a multi-level strategy to define an effective focus for assessment.

Through analysis of existing information, we have established 26 upland, wetland, and aquatic 'coarse filter' units as on focus for assessment. We then evaluated available information on species of conservation concern, including criteria established by BLM in the Scope of Work. For species to be treated in this assessment, we proposed several selection criteria that were approved in AMT workshop 1, including:

a) All taxa listed under Federal or State protective legislation (*including species, subspecies, or designated subpopulations*)
b) Full species with NatureServe Global Conservation Status rank of G1-G3
c) Full species or subspecies listed as BLM Special Status and those listed by applicable SWAPs with habitat included within the ecoregion
d) Full species and subspecies scored as *Vulnerable* within the ecoregion according to the application of the NatureServe Climate Change Vulnerability Index (CCVI).

These criteria result in an initial listing of several hundred species. All species of potential interest to the assessment may therefore be viewed within this "coarse filter/fine filter" framework, establishing:

1) which species are likely to be adequately addressed through assessment of major ecological systems of the ecoregion (e.g., species strongly affiliated with desert springs).
2) which species might be represented as ecologically-based assemblages; i.e., groups of species that could be effectively treated together due to group behavior and similar habitat requirement, like bat hibernacula, migratory bird stopover sites, raptor nesting/foraging zones, etc.;
3) which should be best addressed as individuals in the assessment; and
4) which species will be treated primarily within subsequent sub-assessments

Once this list is finalized, conceptual ecological models (and in many cases, spatial models) will be developed for each to state assumptions about key ecological drivers and evaluate their location and condition over time across the ecoregion. Desired conservation elements follow those listed in the scope of work, and after subsequent discussion, their listing in this memorandum serves to document the current viewpoint of the Assessment Management Team.

Change Agents

Change agents (CAs) are those features or phenomena that have the potential to affect the size, condition and landscape context of conservation elements. CAs include broad regional agents that have landscape level impacts such as wildfire, invasive species, exotic ungulate grazing, climate change, and pollution as well as localized impacts such as development, infrastructure, and extractive energy development. CAs act differentially on individual CEs and for some CEs may have neutral or positive effects but in general are expected to cause negative impacts. CAs can impact CEs at the point of occurrence as well as offsite. CAs are also expected to act synergistically with other CAs to have increased or secondary effects. All change agents have been reviewed to determine potential impacts to conservation elements, if the impact is currently present, will remain present in the future, or is not present but considered a potential future impact. In this assessment we reviewed the list of proposed CAs from the AMT and consulted a variety of sources to:

1. Identify additional potential CAs and whether they are currently affecting the ecoregion, expected to in the future or both.
2. Characterize the ecological effects of the CA
3. Identify potential CEs that would be affected
4. Characterize potential CE impacts

Change Agent Key Recommendations

1. We found the list of candidate CAs provided by the AMT to be highly relevant and recommend inclusion of all for further assessment for data availability and quality. We also recommend adding agriculture (crops and exotic ungulate grazing), alterations to surface water hydrology, as these changes strongly affect fish and other aquatic and riparian CEs. Our recommendation to include exotic ungulate grazing was approved but there is further guidance expected from BLM as to how it is characterized and assessed as a CA.
2. Atmospheric deposition was added in the Air and Water Quality category to address the impacts of acidification of soil, aquatic systems and root dynamics, nutrient enrichment, and mercury contamination.
3. We added a number of invasive species or gave more specificity to aquatic invasives relative to the original AMT lists and subsequent recommendations from workshop participants and written comments.

Recommended Future Research

We anticipate most recommendations for future research to be additive as we filter the CE and CA candidates through the following data assessment and proposed modeling tasks with AMT review and input. Several items are likely to drop out as infeasible in the REA. In this Task we identified the following recommendations for future research:

1. Assess BLM's process and capacity for conducting inventory and monitoring of CEs and CAs across the ecoregion.
2. A considerable breadth of empirical research is likely needed to understand the effects of particular CAs on specific CEs.
3. Some highly specific soil vulnerability assessments were suggested that would require subsequent research to address.

Task 1 Refine Management Questions and Select Conservation Elements

Introduction

Rapid Ecoregional Assessments (REAs) are the first step in the Bureau's Landscape Approach. REAs are intended to synthesize existing knowledge and information applicable to all lands and waters within the ecoregion. This synthesis aims to inform subsequent decision making, implementation, and monitoring by BLM and partners within the ecoregion, and should interact with ongoing scientific research as a foundation for science-based land management. REAs are organized into a series of phases and component tasks. Phase 1 includes tasks that clarify the scope, expected data and modeling approaches to be used, and culminating in a detailed workplan for the analysis. Phase 2 completes the preparation of data, conducts agreed-upon analyses, and documents assessment results. This memorandum summarizes the work, decisions, and remaining issues to be resolved for Task 1, Phase 1 for the Central Basin and Range Ecoregion. Here we initiate the assessment to scope the overall effort, clarify key management questions to be answered, define the ecoregion, establish our criteria and approach for treating selecting and treating focal Conservation Elements, and determine the relevant Change Agents that will be addressed. This memorandum is the final draft (1-c) which incorporates comments on the first draft (Memorandum 1-a) provided at AMT Workshop 1 or submitted separately to BLM.

<u>Task 1 Objectives</u>

The objectives of Task 1 were:

1. Define the assessment region as the ecoregion and a buffer
2. Create a conceptual ecoregion model
3. Review and assess proposed management questions
4. Review and assess proposed conservation elements (CEs)
5. Review and assess proposed change agents (CAs)
6. Conduct a review of recommendations with the AMT
7. Complete initial recommendations to feed into Task 2 data assessment

<u>Memorandum I-a</u>

This memorandum summarizes our assessment and recommendations for each component of the REA based on initial recommendations of the AMT and a rapid assessment from existing studies and contractor staff knowledge. The memorandum is organized according to the Task objectives above. Details are provided in tables in the appendices.

<u>Task Components</u>

I-1.1.1. Conceptual Ecoregion Model, Description, and Assessment Boundary

Assessment Boundary

For Rapid Ecoregional Assessment, conceptual ecological models assist with organizing current knowledge and communicating key assumptions about the environmental controls and dynamics that characterize the regional landscape. Conceptual models commonly include 'box-and-arrow' diagrams, tabular summaries, and textual descriptions. Here, we follow current recommended approaches (e.g., Gross 2005) to organize a conceptual model for the ecoregion. We draw upon a wealth of existing descriptive information, including conceptual models developed for the National Park Service Inventory and Monitoring programs (Miller 2005, Chung-MacCoubrey et al. 2008), ecoregion descriptions of the NRCS (USDA NRCS 2006), US Forest Service (McNab et al. 2007) and the Great Basin Ecoregional Blueprint of The Nature Conservancy (Nachlinger et al. 2001).

The purpose of this model is to articulate key assumptions about regional landscape pattern and process that will inform our selection and analysis of conservation elements and change agents. This overarching description and model will provide a framework for a series of component models for the ecoregion.

First, to define the ***spatial bounds*** of our model, the extent of the Rapid Ecoregional Assessment includes the area within the boundary of ecoregion number 13, as originally defined by Omernik (1987) and EPA (2007) plus the area within a buffer surrounding the ecoregion (Figure 1). The buffer includes that area outside the ecoregion boundary comprised of those 5th-level, 10-digit hydrologic units that overlap the ecoregion boundary. With the buffer area, the extent will have a total area of approximately 138,945 miles^2 359,869 km^2). This buffer may be revisited during later Tasks to ensure it is adequate to capture important CA effects coming into the ecoregion.

The Central Basin and Range lies to the immediate east of the Sierra Nevada, to the north of the Mojave Basin and Range, to the west of the Wasatch/Uinta Mountains, and south of the Northern Basin and Range ecoregions. It is largely defined within the Forest Service's Intermountain Semidesert and Desert Province and M341-Nevada-Utah Mountains Semidesert - Coniferous Forest - Alpine Meadow Province as defined by McNab et al. (2007) and the Western Range and Irrigated Region of NRCS (USDA NRCS 2006). It falls into the Inter-Mountain Basins EcoDivision as defined by NatureServe (Comer et al. 2003). The Central Basin and Range itself is defined quite closely to the Great Basin ecoregion, as defined and used by The Nature Conservancy (Nachlinger et al. 2001).

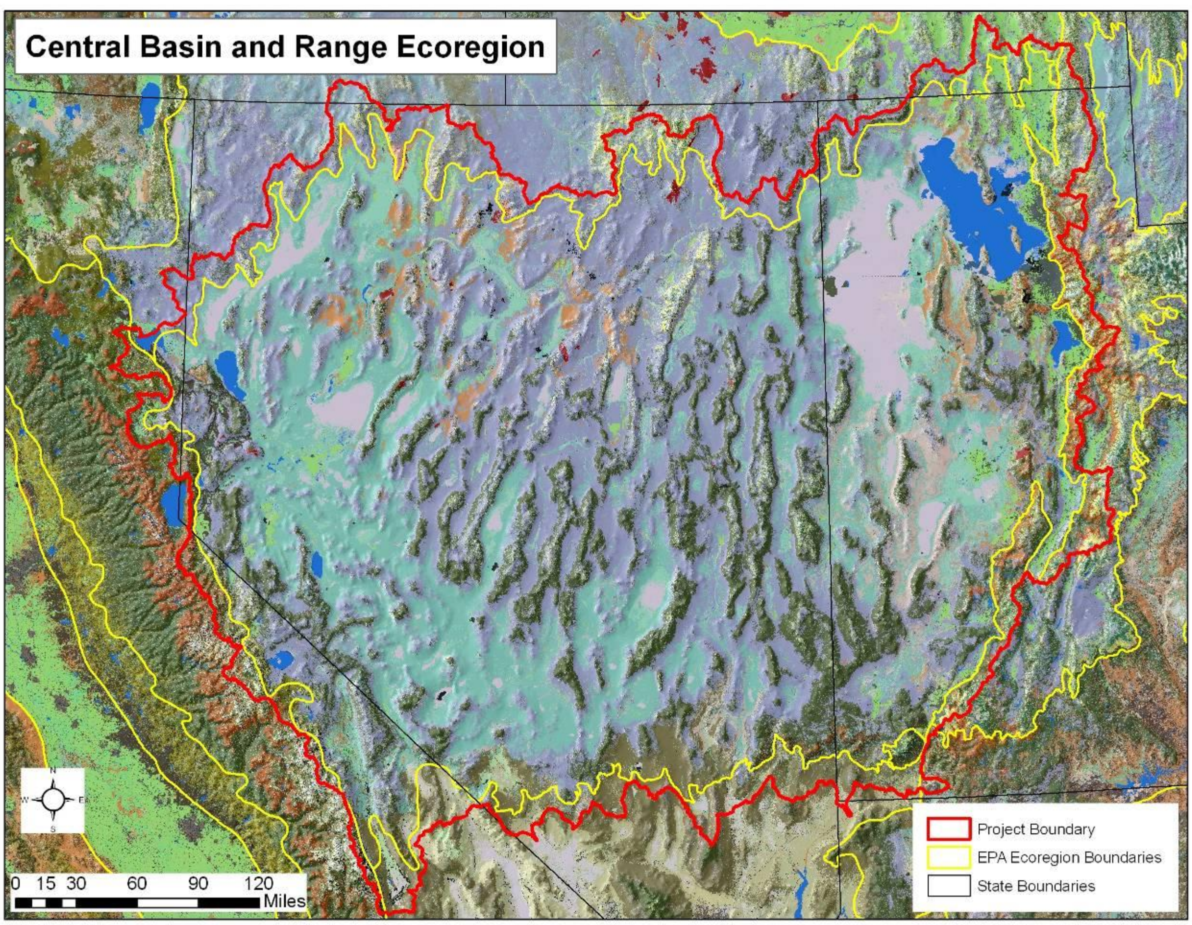

Figure 1. Boundaries for the Central Basin and Range Ecoregion.

As noted in EPA (2007), “The Central Basin and Range ecoregion is internally drained and is characterized by a mosaic of xeric basins, scattered low and high mountains, and salt flats. It has a hotter and drier climate, more shrubland, and more mountain ranges than the Northern Basin and Range (80) ecoregion to the north. Basins are covered by Great Basin sagebrush or saltbush-greasewood vegetation that grow in Aridisols; cool season grasses are less common than in the Mollisols of the Snake River Plain (12) and Northern Basin and Range. The region is not as hot as the Mojave Basin and Range (14) ecoregion to the south and it has a greater percent of land that is grazed.”

The ecological boundary of the Central Basin and Range is more readily distinguished by fairly sharp vegetation changes along its western and eastern edges, with abrupt transitions into high-montane environments. As noted in the EPA ecoregion description, the transitions are less abrupt along the southern borders, as cool semi-desert transitions into the warm desert of the Mojave Basin and Range. The northern transition into the Northern Basin and Range is more subtle, as sagebrush vegetation dominates much of that transition.

Conceptual Model

The ***temporal bounds*** of this conceptual model would include the past two centuries, but center on the 20^{th} century and decade of 2001-2011. This time period reflects the climatic regimes, ecological patterns and processes, and change agents that are most applicable to this assessment. Our assessment will look to future time periods for evaluation of climate-induced stress and land use scenarios, but for conceptual modeling, our initial set of assumptions lead up to today.

Biophysical Controls

Regional Physiography: Between the Sierra Nevada to the west and Wasatch ranges to the east, more than three hundred long, narrow, roughly parallel mountain ranges are separated by broad elongated valleys (Grayson 1993). From Nachlinger et al. (2001), “the valley floors are highest in the center of the ecoregion and lowest at the western and eastern margins, the result of stretching tectonic forces. The structures of mountain ranges are roughly similar, but their compositions are diverse. The structure is the result of high angle block faulting. The ranges are uplifted horsts and the basins are lowered grabens. Granite and basalt mountains occur in the west and south, rhyolite mountains prevail in the center, and limestone mountains predominate in the east. Elevations in the Central Basin and Range range from 324 m (1,063 ft) on the east flank of the Inyo Mountains to 4,342 m (14,246 ft) at the summit of the White Mountains, both in the southwest portion. Valley floors in the Lahontan and Bonneville basins average 1,150-1,525 m (3,800-5,000 ft) above sea level, whereas valley floors in the central sections average 1,675-1,950 m (5,500-6,400 ft) in elevation.”

Regional Climate Regime: Due to its location in the rain shadow of major mountain ranges, the climate of the Central Basin and Range is semiarid. The Sierra Nevada range effectively captures much of the moisture from east-moving Pacific fronts while the Rocky Mountains intercept moisture coming from the Gulf of Mexico. There is also a limited Mediterranean influence (winter precipitation and pronounced dry summers) as defined through some bioclimatic classifications (Sayre et al. 2009; Cress et al. 2009). The climate regime is somewhat continental; with relatively high annual temperature fluctuations due to distance from moderating oceanic climates (Hidy and Klieforth 1990). As Nachlinger et al. 2001 noted, “…Temperatures have both daily and seasonal extreme variation while spatial distinctions occur from valley floors to mountaintops. The mountains tend to be cooler and windier than the valleys. Surface air heating during the day yields very high valley temperatures, often accompanied by strong local turbulence that creates dust devils. At night, valleys lose heat rapidly by radiation and cool air pools below warmer air above. The cold winter temperatures are typically 10 to 40ºF and the hot summers are typically 50 to 90ºF. Daily temperatures vary up to 68ºF, while seasonal averages vary more than 73ºF (<32 to >105ºF). Near the heart of the Central Basin and Range, Elko boasts a 150ºF temperature range, from –43º to 107ºF (Trimble 1989)." However, given the proximity and influence of the Great Salt Lake, temperatures are comparatively moderate. Salt Lake City temperatures average 29ºF in January and 78ºF in July.

Also from Nachlinger et al (2001), "...There are three principal precipitation regimes in the ecoregion. Frontal cyclones from the Pacific cause winter maximum precipitation mostly as snowfall in the western and northern Central Basin and Range. Cold continental cyclones result in spring maximum precipitation in the central and eastern Central Basin and Range. Summer thunderstorms in subtropical air masses from the Gulf of Mexico cause a secondary summer maximum in the southeastern Central Basin and Range, which is often heaviest in the valleys. The average annual regional precipitation is 216 mm (8.5 in), however there is great variation. In Wendover, the average is 114 mm (4.5 in), while at the base of the Ruby Mountains only 95 km (60 mi) to the west, the average is 432 mm (17 in). At the edges of the ecoregion, the average annual precipitation in the rain shadow of the Sierra Nevada is 127mm (5 in), while it is 254 mm (10 in) along the Wasatch Front. No surface water leaves the Central Basin and Range except by evaporation. At Pyramid Lake, evaporation exceeds precipitation about twelve to one."

Due to tectonic stretching, the earth's crust is relatively thin throughout the ecoregion more so than any other place in North America (Fiero 1986), allowing water to percolate from heated subterranean zones. As a result, springs - many of them thermal - are found throughout the ecoregion. Some 30,000 springs are estimated to occur in the Central Basin and Range ecoregion (Sada 2001).

Major Systems for Conceptual Modeling

Here we adapt existing model concepts developed by Chung-MacCoubrey et al. (2008), recognizing climatic and regional physiographic pattern. These pervasive influences of climatic regimes interacting with the basin and range physiography provide overarching biophysical controls on nested systems. Affected in part by variation in solar radiation and air density, seasonal temperature regimes vary along longitudinal, latitudinal, and elevational gradients. Seasonal precipitation regimes vary along these gradients, but are also affected by rain-shadow effects. Combined, these controlling regimes set up regional patterns in wind, dry/wet atmospheric deposition, and air quality (e.g., visibility).

We then define the major model components (Figure 2); acknowledging the central role of water in this desert ecoregion, we first distinguish upland 'dry-land' ecosystems driven generally by water scarcity from aquatic, riparian, and wetland ecosystems driven by water flow regimes. Given the influence of interacting climate and physiography, we distinguish the major model components into "Montane Dry Land" vs. "Basin Dry Land" and "Montane Wet" vs. "Basin Wet" systems. The dry land systems include natural drivers of soil moisture infiltration, erosion, soil organic matter accumulation, and natural disturbance dynamics such as windthrow and wildfire. These vary considerably between higher, cooler montane settings and warmer basin settings. Likewise, "wet" systems, including streams, larger rivers, lakes, springs, desert sinks, wetlands, and riparian environments, are strongly driven by seasonal water flow regimes and the relative influence of surface to groundwater dynamics. Montane wet systems are most strongly driven by surface water flow regimes, while those within the basins combine surface flow dynamics with groundwater flows and evaporation. All of these natural abiotic drivers constrain and influence biotic responses, such as predator/prey dynamics, herbivory, etc.

The human dimension enters as a distinct component model, as socioeconomic and demographic drivers of change in land and water use and policy overlay on other model components. While there are many positive interactions (e.g., economic development, outdoor recreation, and solitude), we see natural drivers such as herbivory, wildfire, and biotic soil crust processes directly altered through exotic ungulate grazing regimes and altered fire regimes in the dry land systems. Predator/prey dynamics are influenced by human/wildlife conflicts, hunting, exotic ungulate (e.g. horse/burro) congregation, and collecting. Land conversion and introduction of invasive plant species closely follow human land use patterns for settlements, energy development (e.g., mining, oil/gas, solar, wind farms, geothermal), irrigated agriculture, or transportation/communication infrastructure. Within wet systems, the human dimension appears through water withdrawals or diversions, water pollution, wetland alterations through hydrologic alteration, conversion, exotic ungulate trampling, or introduction of invasive species.

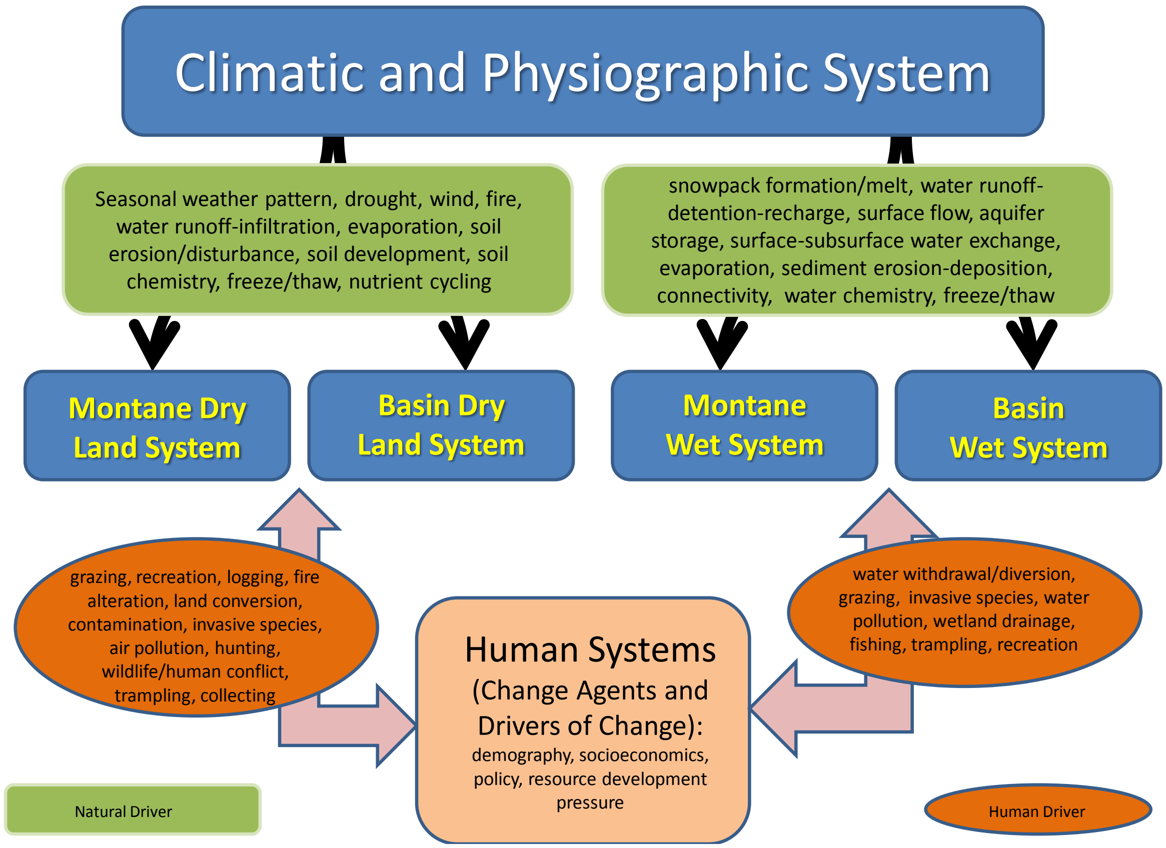

Figure 2. Conceptual Model for the Central Basin and Range Ecoregion

Subsystem models follow from these four broad components. Here we tentatively define categories for regional submodels that will provide organizational cohesion to subsequent assessment. Within each of these component models, we introduce additional detail, organizing natural drivers in terms of "slow physical drivers," such as landform and soil development; properties and processes that change on decadal and longer timeframes, vs. "fast physical drivers," such as wildfire and flooding regimes, soil erosion, and other dynamics that occur over relatively short time frames. Here we also then differentiate the biotic drivers, including the responses and interactions of biota within stated physical bounds and regimes.

The Montane Dry Land System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for alpine uplands, subalpine woodlands and forests, montane mixed conifer forests, pinyon-juniper woodlands, and montane shrublands (including montane sagebrush and chaparrals), and montane cliff and canyon environments (Figure 3). While proportionally more limited in extent than Basin systems, these systems characterize both National Forest and BLM lands thoughout the ecoregion.

The Basin Dry Land System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for semi-desert shrublands, shrub steppe, desert scrub, desert cliff and outcrops, and sand dunes (Figure 3).

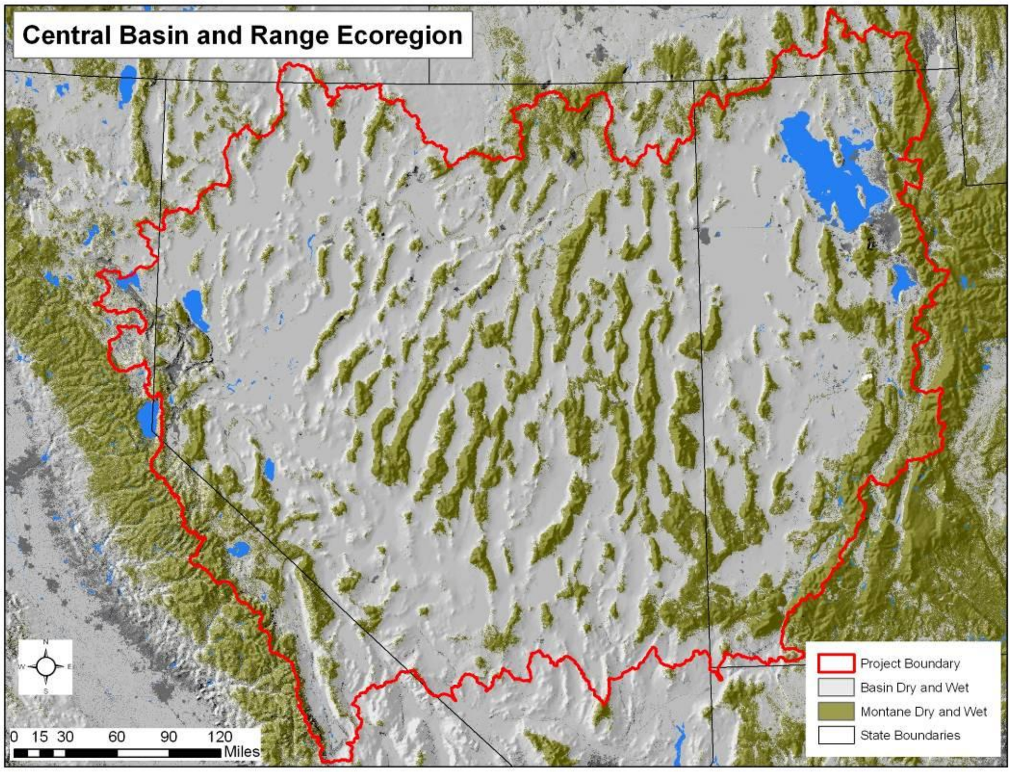

Figure 3. Distribution of Model Components for the Central Basin and Range ecoregion

The Montane Wet System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for alpine-to-montane lakes, streams, wetlands, and riparian communities. Again, of most limited over extent in the ecoregion, these systems characterize both National Forest and BLM lands across the ranges of the ecoregion.

The Basin Wet System will include a series of submodels that encompass landscape pattern, dynamics, and biotic assemblages for low-elevation lakes, streams, desert springs, marshes, floodplain and riparian communities, desert washes, playas and greasewood flats. These component models are depicted in Figure 4 and Figure 5.

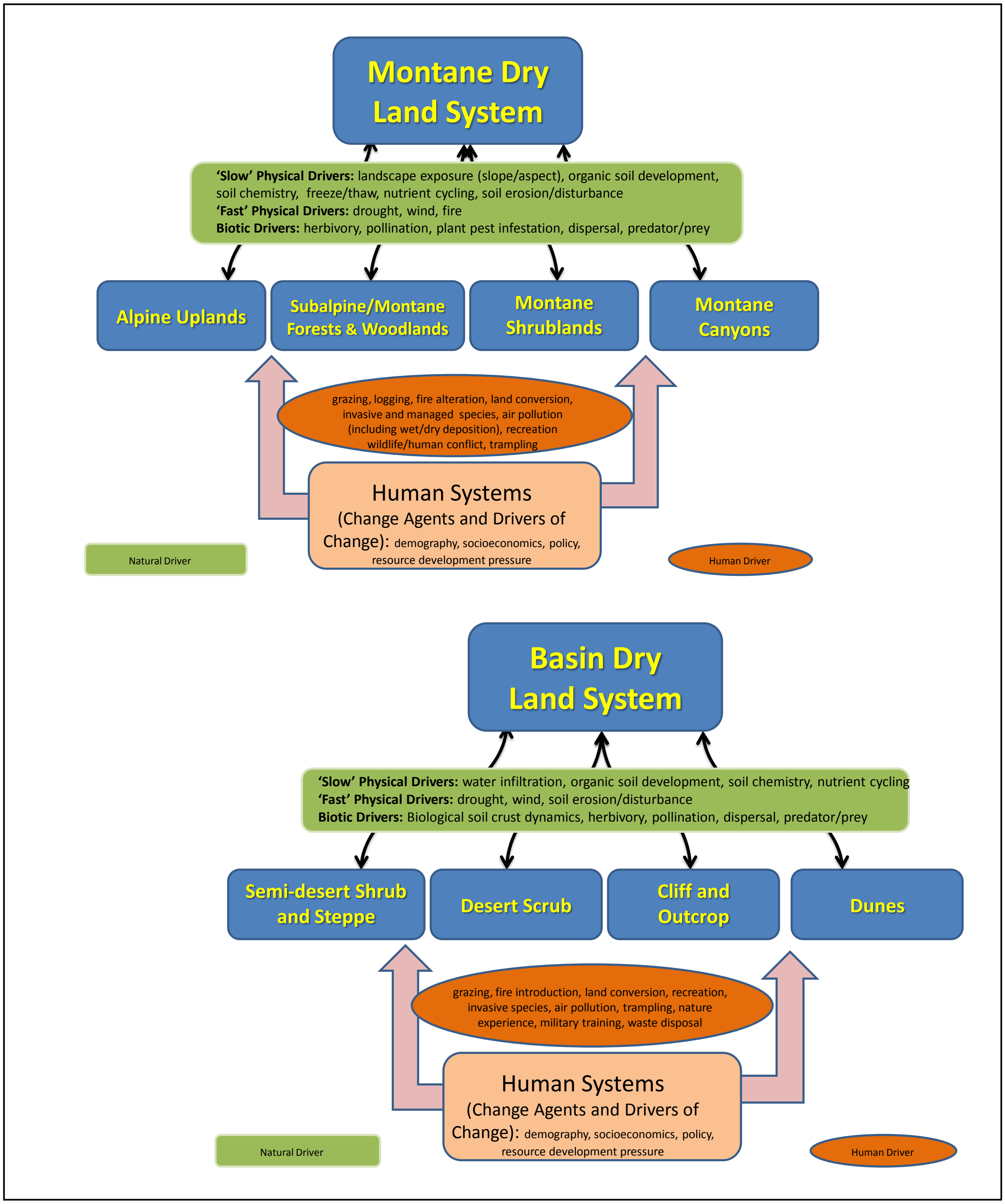

Figure 4. Dry Land Model Components for the Central Basin and Range ecoregion.

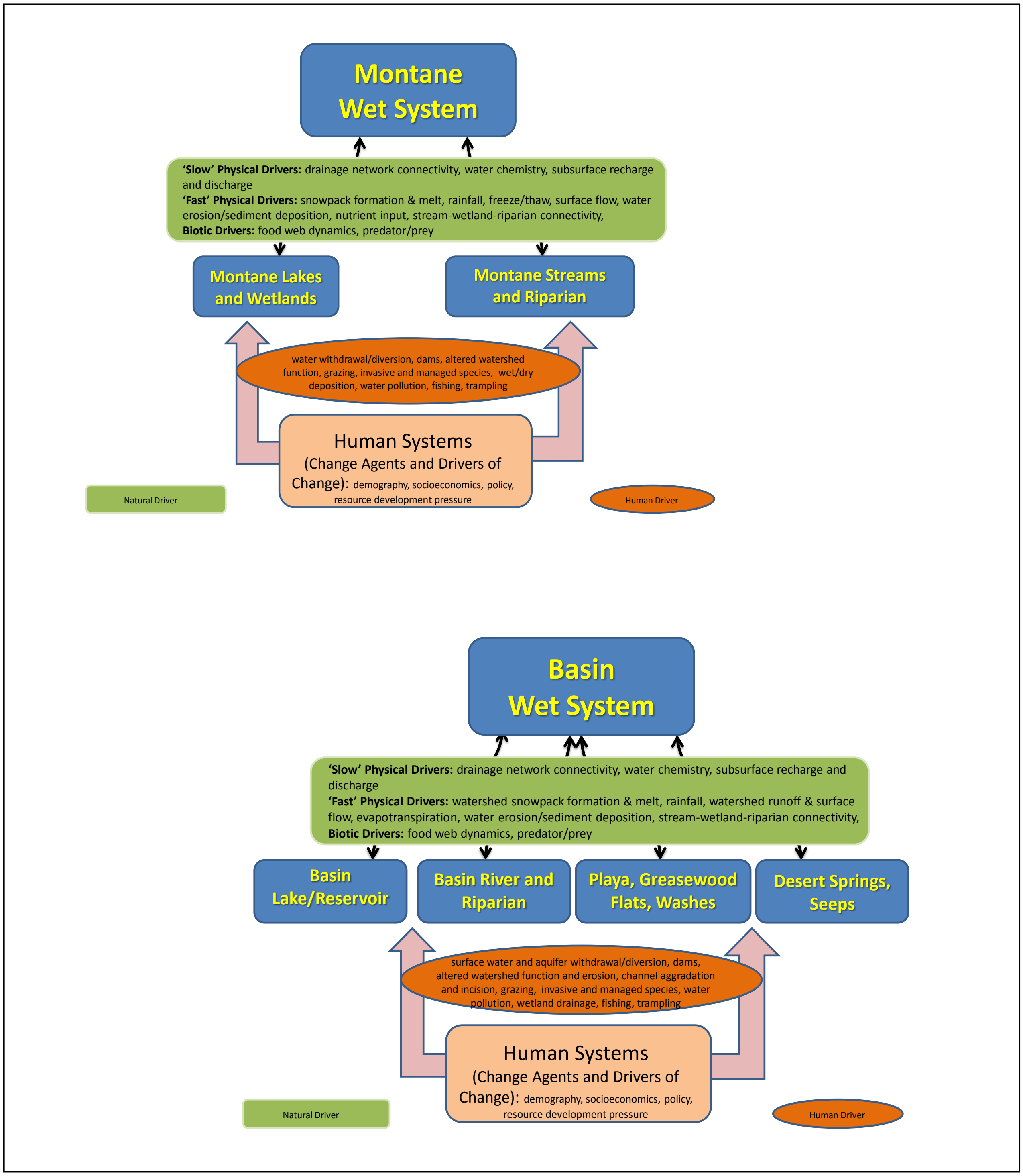

Figure 5. Aquatic Model Components for the Central Basin and Range ecoregion.

Sub-regionalization of the Central Basin and Range Ecoregion

From any perspective, this ecoregion is quite vast. Regional variation in controlling environmental factors affects relative distributions of conservation elements and relative concentrations of many change agents. Given this, many have devised ways to characterize the ecologically-based subdivisions of this vast regional landscape (e.g., Nachlinger et al. 2001; USDA NRCS 2006; McNab et al. 2007). This sub-regionalization may provide a useful tool for organizing analysis, documenting conditions, and reporting on management alternatives.

Given the need to adequately consider both terrestrial and aquatic conservation elements and resources, we recommend careful consideration of options that take these two fundamental aspects of ecological pattern and process into account. In review of existing subregionalizations, we recommend consideration – and potential modification - of the NRCS Major Land Resource Areas, as they apply to this ecoregion. These subregional units provide for useful segmentation of the ecoregion from the perspective of terrestrial ecosystems (Figure 6). **The AMT agreed to use of these concepts and NatureServe will develop a final set of terrestrial subregional units for the ecoregion.** Subsequent conceptual and spatial models for a given conservation element and change agent might vary across these subregions, to better reflect local circumstances.

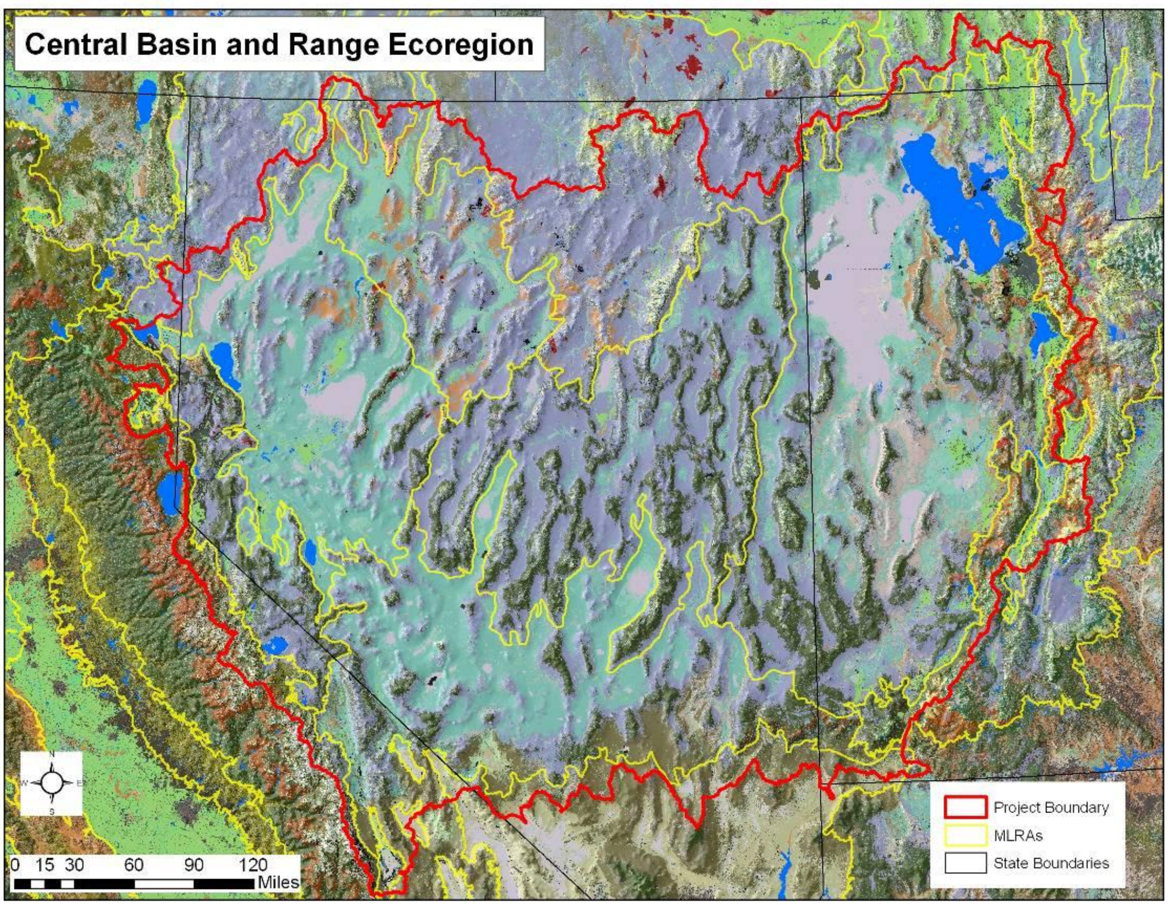

Figure 6. Major Land Resource Areas applicable to the ecoregion.

Similarly, The Nature Conservancy completed freshwater aquatic community classification of this ecoregion, and through that process, established series of ‘ecological drainage units’ that serve a similar function from an aquatic perspective (Figure 7). **We recommended, and the AMT approved use of these drainage units for defining aquatic subregions for this assessment.** NatureServe will implement this task by creating a project specific map for these purposes.

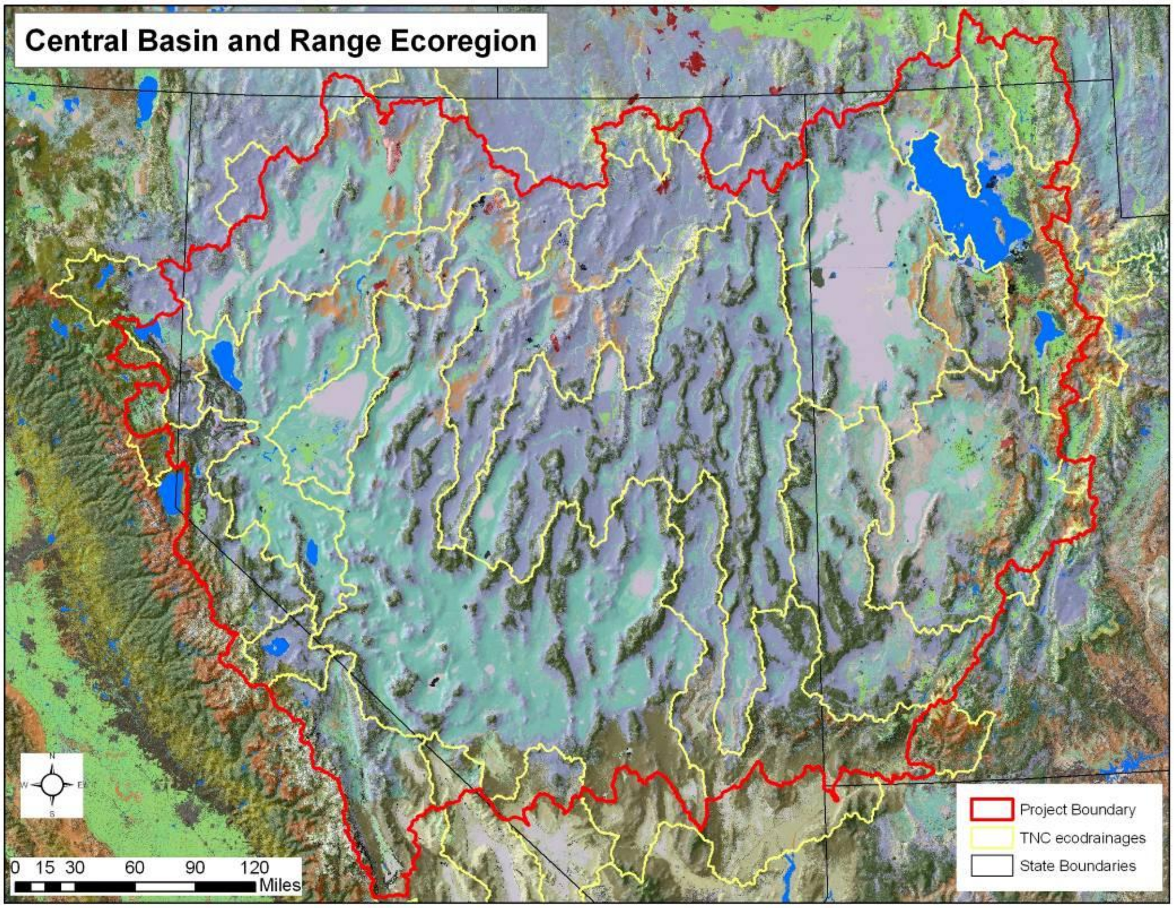

Figure 7. TNC Ecological Drainage Units applicable to the Central Basin and Range ecoregion.

I-1.1.2. Management Questions

Individual Management Questions (MQs) address specific needs for information that will ultimately inform management actions on the landscape. Individual MQs are driven by a iterative dialog among three aspects of land management planning: (1) an understanding of the ecological systems and social context (which are embodied in the conceptual ecological models), (2) the entities that are of concern and are under management (i.e., Conservation Elements or other entities of interest), and (3) the processes or activities that can effect change in the managed landscape (i.e., Change Agents). Collectively, the set of MQs "roll up" to create understanding about status and trends in the landscape and identify threats. Importantly, the collection of MQs can also identify the landscape's ecological integrity, its resilience, and opportunities for constructive and effective management.

A goal of Task 1 is to develop a set of strong and virtually MQs. Continued adjustments to the questions will be made throughout Phase 1 of the work, but Task 1 and the discussions during Assessment Management Team Workshop 1a (AMT1) will produce a strong penultimate set of questions. BLM provided a preliminary set of 70 MQs in 19 groups. We refined these preliminary MQs using seven criteria.

(1) Is each MQ stated in a clear and focused way that can be commonly understood by all participants?

(2) Is each MQ matched to and answerable with available data and planned analyses?

(3) Are there important issues or questions missing from the list of MQs?

(4) Are there MQs that are extraneous, duplicative, or determined to be of lesser importance?

(5) Do any MQs suggest Conservation Elements or Change Agents that are missing from the target lists (under development) for the project?

(6) Are all Conservation Elements and Change Agents addressed in at least one MQ?

(7) Are each of the MQs clearly incorporated somewhere into the ecological models under development for the project?

Applying these criteria led to adjustments to the text and phrasing of proposed adjustments MQs and a small number of additions and deletions. These proposals and their rationale were presented in Memo I-1-a and further discussed during AMT1. The increased clarity concerning BLM's needs for information and the precise meaning of terms resulted in the penultimate set of MQs presented here.

Box 1. Groups of Management Questions, followed by the number of questions in the group (in parenthesis). There are 81 MQs in 20 groups.

- Species (9)
- Native Plant Communities (4)
- Terrestrial Sites of High Biodiversity (3)
- Aquatic Sites of High Biodiversity (4)
- Specially Designated Areas of Ecological Value (1)
- Wild Horses and Burros (7)
- Soils (3)
- Surface and Subsurface Water Availability (6)
- Aquatic Ecological Function and Structure (2)
- Fire History (2)
- Fire Potential (2)
- Invasive Species (4)
- Development (5)
- Groundwater Extraction and Transportation (7)
- Surface Water Consumption and Diversion (5)
- Climate Change: Terrestrial Resource Issues (6)
- Climate Change: Aquatic Resource Issues (4)
- Military Constrained Areas (3)
- Bald Eagles, Golden Eagles (2)
- Atmospheric Deposition (1)

Note that we refer to this set of MQs as "penultimate" because additional modifications to MQs are likely throughout Phase 1 of the REA. For example, Task 2 investigates the availability of data to address each question (see criterion #2); Task 3 creates a set of detailed conceptual models for CEs (criterion #7) that may determine the final working definitions of terms that affect analysis. The original set of MQs provided by BLM is not included in this document, but can be reviewed in Memo I-1-a (App. 1).

Our complete proposed set of MQs can be found in App. 1 and is based on the groundwork described in Memo I-1-a and the discussions of AMT1. The resulting list includes 81 proposed MQs in 20 categories (Box 1). Each of the MQs listed in App. 1 is cross-referenced with CEs and/or CAs to which it pertains. There is also a "Notes" field that describes any outstanding issues that require resolution (such as definitions of terms that will be clarified during the conceptual modeling period, Task 3).

We note that the preliminary MQs for the Central Basin & Range and the Mojave Basin & Range were broadly similar, and in many cases identical. Discussions at AMT1 further reduced distinctions between the sets of questions. Although the lists for the two ecoregions are still not identical (due to ecological subtleties and small differences in needs for information), wherever the questions clearly addressed the same issue we have standardized the wording of the MQ. This will facilitate analysis and reduce confusion when comparing results across ecroregional boundaries.

"Where" Questions: Although there are 20 substantive categories of MQs in Box 1 (e.g., "Species", "Climate Change: Terrestrial Issues", etc), many important MQs are expressed as simple "Where" questions based on existing data. There are "Where" questions in every category of questions. For example, where Golden Eagle nests found? Where are surface water features? They require minimal formal analysis and are typically geospatial descriptions of the locations of CEs, the presence of CAs, features such as aquatic resources, and other data entities or processes of interest. General examples of such important "Where" questions are shown in Box 2. Note that "Where" questions repeat themselves throughout the complete list of MQs in App. 1, and across all of the groups.

A powerful land management analysis can result from overlaying the results of "Where" questions to identify areas of potential management concern. For example, a simple overlay of the distribution of each CE and each relevant CA produces, for each CE, map of potential impacts from each CA. Of course, such a map of potential effects does not demonstrate an

Box 2. Major Classes of "Where" Questions

• Where are (or what is the distribution of) CEs, features, and processes of importance (species, native communities, biodiversity sites, refugia, aquatic communities)?
[Applied to all CEs.]

• Where are critical habitats or landscape features (e.g., water bodies, ecological connectivity, restoration areas, protected areas)?

• Where are locations of action by Change Agents (both ecological and anthropogenic)? [Applied to all CAs.]

Studying the simple geographic overlap among these classes of questions identifies:

(1) areas that may experience the most significant ecological change, and;

(2) opportunities for high impact management action.

Box 3. Emergent or "Roll Up" Management Questions that Concern Integrity and Resilience

• What qualities or attributes of the ecoregion contribute (positively or negatively) to the ability of the ecoregion's ecological systems to resist or respond to disturbance and change?

• How are these qualities distributed across the ecoregion?

• How might their distribution be affected by climate change, development, and other change agents?

• Where are opportunities for effective ecological management?

existing impact or problem, but (1) can help prioritize locations that warrant further investigation and (2) identify opportunities for high impact management action.

Other MQs may be based on more complicated development of indices or projections into the future. For example, Climate Change analyses require the melding of climate projections with understanding of how ecological processes and climate correlate. In some cases the precise wording of such MQs may not be resolved until near the end of Phase I. However, MQs that make predictions of future states and trends will be a critical part of the REA.

Emergent Management Questions: Collectively, the MQs are meant to create a picture of the overall health and integrity of the ecoregion, the threats to it, and point to locations of potentially effective and sustaining high-impact management actions (Box 3). The exact nature of such emergent questions will clarify and evolve as analyses are accomplished.

Conservation Elements

I-1.1.3. Conservation Elements (CEs)

Introduction

A first step in most natural resource assessments is the identification of the features to provide a focus (Margules and Pressey 2000, Groves et al. 2002, Stoms et al. 2005). We must ask and answer: ***What is it that we wish to evaluate and assess?*** For Rapid Ecoregional Assessments, we refer to these as "conservation elements." These elements could include habitat or populations for plant and animal taxa, such as threatened and endangered species, or ecological systems and plant communities of local interest. A list of conservation elements could also include other resource values, such as highly erodable soils, populations of wild horses and burros, scenic viewsheds, or already designated sites of natural, historical or cultural significance.

Key to selection of conservation elements is establishing clarity of purpose. ***What do we need to learn from the assessment?*** For this REA, we propose a two-track focus for assessment. One track focuses on the ecological resources of the ecoregion, supporting regional biodiversity and providing the major ecosystems services. This track emphasizes assessment of ecological integrity of landscapes and waterscapes (*sensu* Parrish et al. 2002, Unnasch et al. 2008, etc.). These define our **Core Conservation Elements.** The second track augments the first by including additional resource values of interest to agencies and stakeholders. These define our **Desired Conservation Elements.**

For our first track, we encounter the dilemma of selecting an efficient list of elements that will help us to adequately address the complexity of natural ecosystems. We seek an effective focus to articulate our assumptions about key ecological drivers of natural systems. If we can do this, we will then seek to effectively gauge the relative effects of change agents on these important natural resources. Our dilemma is that we cannot practically take a 'species by species' approach, hoping to account for all aspects of their individual life histories. Many thousands of species, from large-bodied carnivores, to vascular and non-vascular plants, to soil microbes occur across each ecoregion, precluding this approach. We are *always* forced to select some type of 'surrogate' to represent whole suites of species and the main ecological processes that define a given landscape.

We proposed, and the AMT agreed, to take a "coarse filter/fine filter" approach to selecting core conservation elements, and treating them in this assessment. This approach was originally proposed by scientists from The Nature Conservancy (Jenkins 1976, Noss 1987, Hunter 1990) and used extensively in a variety of forms for regional and local landscape assessments (Nachlinger et al. 2001, Noss et al. 2002, etc.). It focuses primarily on ecosystem representation, complimented by a limited subset of focal species assemblages and individual species. 'Coarse-filter' focal ecological resources are identified first, and typically include all of the major ecosystem types within the assessment landscape. The intent of this focus is to represent all of the predominant natural ecosystem functions and services in the ecoregion. Researchers and managers then consider whether individual species of concern - those that are in some way 'vulnerable' to being lost - have habitat requirements that are adequately represented by the coarse filter units. That is, we pose the question; if all major ecosystem types are managed and conserved in sufficient area and landscape configuration, which of the 'vulnerable' species will have sufficient habitat "swept along"? Those species that are ***not*** adequately addressed through ecosystem-scale conservation are included as additional foci for assessment – the "fine filter." This approach therefore sets up a multi-level approach to define an effective focus for assessment.

Building from the framework of our ecoregional conceptual model, we first identified the major ecological systems for the ecoregion as one focus for assessment. All species of potential interest to the assessment may therefore be viewed within this "coarse filter/fine filter" framework, with specific criteria established for the selection and treatment (see below). Again, our intent is to provide an effective focus for assessment. Once this list is established, conceptual ecological models will be developed for each to state assumptions about key ecological drivers.

Selecting Core Conservation Elements

Our candidate lists reflect our proposal to apply a 'coarse filter/fine filter' approach to identify ecosystem, species assemblages, and individual species that collectively should aid in assessing ecological integrity across the regional landscape. From the established Scope of Work, this encompasses the listed Native Fish, Wildlife, or Plants of Conservation Concern, Regionally Important Terrestrial Ecological Features, Functions, and Services, and Regionally Important Aquatic Ecological Features, Functions and Services. We completed an initial analysis of NatureServe central databases and 'conservation target' lists from the Nature Conservancy ecoregional plans to identify species that meet BLM stated criteria for "Other Priority Wildlife (& Plant & Aquatic) Species;" as well as all federally listed species. This generated our initial master list of species of potential conservation concern for the ecoregion.

Coarse-Filter Elements

The "coarse filter" includes 26 terrestrial and aquatic ecological system types and communities that express the predominant ecological pattern and dynamics of the ecoregion (Table 1). These classified units a) characterize each component of the ecoregion's conceptual model, b) define the vast majority of this ecoregion's lands and waters, and c) reflect described ecological types with distributions concentrated within this ecoregion. By treating these in our assessment we aim to adequately treat the habitat requirements of most characteristic native species, ecological functions, and ecosystem services. Ecological models (both conceptual and spatial) for these coarse filter elements will form a major focus for this ecoregional assessment. NatureServe ecological classifications provided the basis for several existing national or regional map products (e.g., NatureServe national map, ReGAP in CA and SW region, LANDFIRE EVT & BpS, etc.) and/or may be readily reconciled with locally-desired classification systems for plant communities (see http://www.natureserve.org/explorer/ for more detailed descriptions of ecosystem types listed in Appendix 2). We used NatureServe databases and existing map products to establish our proposed list of these core CEs. Appendix 2 includes an annotated listing for each of the upland and wetland examples of these coarse filter units. Those that are entirely aquatic (e.g., lakes, reservoirs, etc.) have yet to be fully examined for their relationships to aquatic coarse filter CEs.

Table 1. Coarse-Filter Conservation Elements for Central Basin and Range Ecoregion

Ecosystem Name	% Ecoregion	Land Cover Class
Basin Dryland Ecosystems	**55.8%**	
Inter-Mountain Basins Mixed Salt Desert Scrub*	20.0%	Short Shrubland
Inter-Mountain Basins Big Sagebrush Shrubland	19.5%	Shrub-steppe
Great Basin Xeric Mixed Sagebrush Shrubland	9.6%	Short Shrubland
Inter-Mountain Basins Semi-Desert Shrub-Steppe	3.1%	Shrub-steppe
Mojave Mid-Elevation Mixed Desert Scrub	2.0%	Short Shrubland
Inter-Mountain Basins Semi-Desert Grassland	1.0%	Upland Grassland and Herbaceous
Inter-Mountain Basins Big Sagebrush Steppe	0.3%	Shrub-steppe
Inter-Mountain Basins Active and Stabilized Dune	0.2%	Sparsely Vegetated
Colorado Plateau Mixed Low Sagebrush Shrubland	0.1%	Dwarf-shrubland
Great Basin Semi-Desert Chaparral	0.0%	Tall Shrubland
Basin Wet Ecosystems	**11.0%**	
Inter-Mountain Basins Playa	5.7%	Sparsely Vegetated
Inter-Mountain Basins Greasewood Flat	5.1%	Woody Wetlands and Riparian
North American Arid West Emergent Marsh and Pond	0.2%	Herbaceous Wetlands
Inter-Mountain Basin Desert Wash	no estimate	Sparsely Vegetated
Great Basin Lake/Reservoir	no estimate	Aquatic
Great Basin Springs and Seeps	0.0%	Aquatic
Montane Dryland Ecosystems	**19.5%**	
Great Basin Pinyon-Juniper Woodland	13.8%	Evergreen Forest and Woodland
Inter-Mountain Basins Montane Sagebrush Steppe	3.9%	Shrub-steppe
Inter-Mountain Basins Cliff and Canyon	0.7%	Sparsely Vegetated

Ecosystem Name	% Ecoregion	Land Cover Class
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	0.6%	Mixed Evergreen-Deciduous Forest and Woodland
Rocky Mountain Aspen Forest and Woodland	0.2%	Deciduous Forest and Woodland
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	0.2%	Evergreen Forest and Woodland
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	0.0%	Mixed Evergreen-Deciduous Forest and Woodland
Montane Wet Ecosystems	**1.3%**	
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland/Stream	1.2%	Woody Wetlands and Riparian
Rocky Mountain Alpine-Montane Wet Meadow/Alpine Lake	0.0%	Herbaceous Wetlands
Rocky Mountain Subalpine-Montane Riparian Woodland and Shrubland/Stream	0.0%	Woody Wetlands and Riparian

***those bolded reflect types referenced directly in scope of work**

Fine-Filter Elements

Again, the "fine-filter" includes species that, due to their conservation status and/or specificity in their habitat requirements, are likely vulnerable to being impacted or lost from the ecoregion unless resource management is directed towards their particular needs. We propose to treat species falling within this general category into two subcategories; a) those that might be effectively treated as a species assemblage; i.e., their habitat and known populations co-occur sufficiently to treat them as a single unit of analysis, and b) those species to be treated individually.

For species to be treated in this assessment, we proposed, and the AMT accepted, several selection criteria for inclusion and treatment in the assessment. These criteria include:

a. All taxa listed under Federal or State protective legislation (including species, subspecies, or designated subpopulations)

b. Full species with NatureServe Global Conservation Status rank of G1-G3[1]

c. Full species or subspecies listed as BLM Special Status and those listed by applicable SWAPs with habitat included within the ecoregion

d. Full species and subspecies scored as *Vulnerable* within the ecoregion according to the NatureServe Climate Change Vulnerability Index (CCVI).

Appendix 4a includes a draft list for the ecoregion for species under criteria a-b above. Additional effort will now be undertaken to integrate existing information and confirm species that would meet criterion c) by reviewing state lists of BLM Special Status Species, and those listed under applicable SWAPs, to extablish those species with habitat included within the ecoregion.

Criterion d) involves application of the NatureServe CCVI to candidate species that might otherwise NOT be included in the assessment, but for their resulting status under the CCVI. Specific selection criteria for the sub-analysis include:

[1] See http://www.natureserve.org/explorer/ranking.htm for NatureServe Conservation Status Rank definitions

1) Taxa listed of conservation concern in the Great Basin Ecoregional Assessment of The Nature Conservancy (Nachlinger et al. 2001).

2) Full species with NatureServe Global Conservation Status rank of G3?-G3G4

3) Subspecies with NatureServe Status Rank of T1-T3

Appendix 4b includes a draft list for the ecoregion for species under criteria c-d above. Each of these categories should help to identify species that, while they have been of some limited conservation concern within the ecoregion, concern will likely increase within coming decades. Subsequent application of the CCVI would distinguish those of greater likelihood to the affected by climate-induced stress over coming decades, and be more likely to face further declines. Preventive management action to benefit these species would therefore be advisable.

Treating Core Conservation Elements in the Assessment

As previously stated, a "coarse filter/fine filter approach" intends to provide an effective focus for assessment. This applies both to criteria for selection of component elements, and to the various means of their treatment for analysis. Representative ecological types, as listed in Table 1 form our initial focus of assessment, and will be treated through mapping, modeling, and varios assessment methods. We then proposed and established several distinct approaches to treating species that meet established criteria for inclusion in the REA. These include:

- Species assumed to be adequately ***represented indirectly through the assessment of major "coarse-filter"*** ecological systems of the ecoregion. For example, species strongly affiliated with desert springs may be adequately treated in the REA through assessment of desert springs themselves.
- Species assumed to be adequately ***represented indirectly as ecologically-based assemblages***. That is, due to group behavior and similar habitat requirement, a recognizable species assemblage is defined and treated as the unit of analysis. Examples could include bat hibernacula, treating multiple species of bats; all or some of whom are of conservation concern. Similarly, migratory bird stopover sites or raptor nesting/foraging zones could also be treated as multi-species assemblages.
- Species which should be ***best addressed as individuals*** in the assessment. These include those species meeting our criteria for assessment that cannot be presumed to be included in the previous two categories. This will tend to include many major 'landscape' species that range over wide areas within the ecoregion and with clearly distinct habitat requirements from all other taxa of concern.

Finally, for species of concern from the latter category that have ***very narrow distributions; limited to one BLM management jurisdiction,*** we will gather current locational information, but will not aim to develop conceptual models for these elements. We will continue to work with the AMT to determine appropriate menas to spatially represent these elements e.g., as concentration zones of CEs, etc. Otherwise, these elements will be treated within sub-assessments subsequent to the REA. Appendix 4 provides a summary listing of candidate species for this REA. Subsequent efforts by our team, securing input from other regional botanists and wildlife ecologists, will finalize the selection and treatment of species within this REA.

As one preliminary step towards this refinement phase, we then completed a preliminary analysis of approximately 15,000 locality records for species of potential conservation concern, combining known localities with current maps of terrestrial ecological systems. This enabled an initial exploration and identification of habitat-based species assemblages for treatment in this assessment. Appendix 5 includes a list of upland species that might be adequately addressed in the assessment via analysis of 'coarse filter' ecological systems. Of the known localities for these species, 50-100% coincide with one ecological system type. A similar analysis is in progress for aquatic species (Appendix 6). We believe these species respond sufficiently closely to the prevailing ecological processes supporting each coarse-filter ecological system type, that for purposes of this assessment, this would be the most effective approach. Again, we will complete additional expert analysis of these species to finalize habitat-based listings for species of concern.

Desired Conservation Elements

We will to include Mule Deer and a limited set of soil types of conservation concern (e.g., highly erodable soils) in the assessment. We will gather locational information on Areas High Biodiversity Significance, Specially Designated Areas of Ecological Value, but these do need not be treated as conservation elements. They may be effectively categorized as "reporting units." Assessment reporting can be completed with respect to these features without treating them directly as conservation elements.

Summary of Recommendations for Conservation Elements

Table 4 includes a concise summary by category of conservation elements that we propose for this ecoregional assessment. A master list of candidate species elements for the ecoregion, including additional descriptive attributes, is found in Appendix 4.

Table 2. Summary of Proposed Conservation Elements for Central Basin and Range Ecoregion.

Conservation Element Category	**Number of Elements**
Basin Dryland Ecosystems	10
Basin Wet Ecosystems	6
Montane Dryland Ecosystems	7
Montane Wet Ecosystems	3
Nested Terrestrial Habitat-Based Species Assemblages	not yet established
Nested Aquatic Habitat-Based Species Assemblages	5 *(approx.140 species included)*
Species (potential candidates from all categories)	
Plants	369
Animals	574
Desired Conservation Elements	
Mule Deer	
Soils of Conservation Concern (high erodability)	

I-1.1.4. Change agents (CAs)

Change agents are those features or phenomena that have the potential to affect the size, condition and landscape context of conservation elements. CAs include broad regional agents that have landscape level impacts such as wildfire, invasive species, exotic ungulate grazing, climate change, and pollution as well as localized impacts such as development, infrastructure, and extractive energy development. CAs act differentially on individual CEs and for some CEs may have neutral or positive effects but in general are expected to cause negative impacts. All effects are expected to be accounted for in the REA. CAs can impact CEs at the point of occurrence as well as offsite. CAs are also expected to act synergistically with other CAs to have increased or secondary effects. All change agents have been reviewed to determine potential impacts to conservation elements, if the impact is currently present, will remain present in the future, or is not present, but considered a future impact. In this assessment we reviewed the list of proposed CAs from the AMT and consulted a variety of sources to:

1. Identify additional potential CAs and whether they are currently affecting the ecoregion, expected to in the future or both.
2. Characterize the ecological effects of the CA
3. Identify potential CEs that would be affected
4. Characterize potential CE impacts

Change Agent Classes

Below we characterize the four classes of change agents and their major subclasses. Each class and subclass is given more detailed treatment in Appendix 3.

<u>Class I Wildland Fire</u>

Alterations to the expected natural fire regimes, through active fire suppression and/or introducing novel fire regimes with exotic weed species, can significantly alter vegetation structure and composition, leading to habitat degradation among CEs and increased risk of uncontrollable wildfire events. In Task 2 we will review and evaluate model outputs of inter-agency LANDFIRE (Landfire 2007) and SAGE MAP (Wisdom et al. 2003) efforts and characterize fire regimes for predominant vegetation, then evaluate mapped outputs to determine their suitability for characterizing current and expected future conditions. Where applicable, future climate projections will inform conceptual, tabular, and spatial models of expected future fire regime conditions, given practical assumptions of future land use configurations.

<u>Class II Development</u>

This class contains a broad variety of CAs with very different CE effects; we therefore describe subclasses below. Some subclasses may likely be further divided for assessment (e.g., low density exurban development vs dense urban):

- Urbanization: The Central Basin ecoregion has recently seen very rapid population growth and urbanization. Nevada and Utah had two of the fastest growing state-level populations in the country from 2000 to 2009. Among the 100 fastest growing counties in the US are Lyon and Nye, NV; and Iron, Tooele, and Washington, UT. The city of Reno has grown at a rate of 20% from 2000 to 2009. Typically, the rapid population growth rate also means a concomitant rate of urbanization, or expansion of the urban footprint. In fact, the extent of urban or built-up land cover increased by over 76% in NV from 1997 to 2007 (USDA NRCS 2007) to cover 582,000 acres – roughly twice the rate of population growth! Urbanization expanded at a rate equal to the population growth rate in Utah (23.7%; 744,000 ac). We will include models of urban expansion that take into account transportation plans as far as they currently exist.

- Infrastructure (roads, pipelines, transmission lines, water transmission, railroads): infrastructure displaces habitat for CEs and creates movement barriers, creates bird collision features, removes nesting cover, increases travel lanes for predators and perch sites for avian predators (WAPT 2006). Increases fragmentation-- reducing ground nesting species, increases predator pressure (WAPT 2006), alters hydrology, and introduces invasive species.
- Energy development: We describe extractive vs renewable energy types separately below
  - Renewable energy development (wind, solar, geothermal & biomass): In the short term, the Central Basin is poised to receive at least 10 large renewable energy projects under the Fast-Track Renewable Energy Program (Nevada BLM 2010). These projects and subsequent projects will take advantage of the region's abundant wind, solar and geothermal potential. These developments will destroy or alter habitat at-site as well as require new roads and ROW to support them. Wind turbine impacts on birds (mortality, alteration of habitat use) have been documented but the effects vary greatly according to the sighting of the facility and type of technology used (Barrios & Rodriguez 2004; Drewitt & Langston 2006). Some older facilities have high mortality rates (Orloff & Flannery 1992) while many newer facilities have very low mortality rates (Osborn et al. 2000). Some researchers have speculated that solar thermoelectric facilities (STF) may negatively impact insects and birds which inadvertently fly into high temperature areas (Mihlmester et al. 1980). Some proposed STF may use water drawn from desert aquifers which also creates concern (Beamish 2009). While overall biomass is low in the Central Basin, proposals have surfaced to harvest juniper-pinyon forests for biomass energy in NW California and Nevada.
  - Extractive energy development (oil, gas): This CA impacts CEs by destroying or altering habitat, creating bird collision features, introducing invasives, causing ground water pollution and volume changes, and creating movement barriers.
- Hydrologic CAs
  - Groundwater withdrawals pose significant threats to aquatic CEs in the ecoregion, where basin-fill and bedrock groundwater levels provide crucial baseflows to perennial streams and sustain crucial water levels in spring ecosystems. In many cases, existing rates of withdrawal already threaten many groundwater-dependent ecosystems in the ecoregion; increases in withdrawals could accelerate impacts to already-threatened ecosystems and expand the geographic scope of such impacts. Such impacts could include shrinkage of perennial stream lengths, decreases in stream baseflow and concomitant increases in baseflow temperature, and reduced spring water levels or discharges, all of which would affect hydrologically and temperature-sensitive aquatic species and communities (e.g., Deacon et al. 2007). Additional potential impacts are: reduced extent of perennial stream flows (gaining stream reaches), increased extent of dry streambeds (losing stream reaches), lower water levels and altered hydrologic regime of springs and seeps, and altered alluvial soil moisture regimes in riparian zones (Deacon et al. 2007)
  - Altered Surface Flow Connectivity – dams, culverts and stream crossings cause alterations to habitat that make stream reaches unsuitable for species movement. Barriers to movement of aquatic fauna and transport of riparian plant propagules can reduce ability of streams to recolonize reaches following disturbance and prevent aquatic animals from completing life-cycle changes (Deacon et al. 2007, Pringle 2000, Pringle 2001).
  - Altered Surface Flow – include flood control, diversions, spring impoundments, etc. Altered stream and river flows caused by water diversions and flow manipulation (e.g., storage and release operations) result in diverse ecological consequences that become

more severe the greater the degree of alteration of key components of the flow regime (magnitude, frequency, timing, duration of ecological flow components, managed flow that does not account for seasonal flooding, for example) and alterations to sediment regimes (increased sediment can decrease spawning habitat) which effects the reproduction and survival of riparian and aquatic CEs , and can decrease overall riparian habitat (Deacon et al. 2007, Pringle 2000, Pringle 2001)

- Mining (all minerals and materials): Mining has similar effects to other development along with radical hydrologic change (for example, dewatering), increased fragmentation of habitat and increased dust sources. Abandoned mines continue to be a point source of heavy metals and exhibit soil compaction and soil contamination that lasts >70 years preventing natural plant succession (Knapp 1992). Current mines and quarries can destroy raptor nesting locations (Bates 1985)
- Military use/expansion areas: The use of military lands focuses on training exercises and the support of the military mission. The DOD has made significant steps towards reducing or avoiding long term impacts on natural resources (Prose 1985). In the Southwest, the DOD has proactively engaged regional land management organizations and taken an active role in managing natural resources and indeed some bases have often been effective havens for species. Despite this training activities (namely motorized and artillery maneuvers) reduce vegetation cover, disturb crusts, and degrade and compact soils (Prose 1985; Steiger and Webb 2000). This makes the land more vulnerable to wind erosion (Milchunas et al. 2000; Van Donk 2003) and weed infestation. Military reservations are also subject to pollution and contamination by hazardous substances (GAO 1994). The range of impacts will depend widely on the branch of service in question and the missions supported by each base.

  Military activities have generated impacts off reservations, usually in the form of noise pollution (primarily from low-flying aircraft) which has been shown to stress wildlife (Weisenberger et al. 1996) although studies have been unable to document significant impacts due to military noise (Krausman et al. 1998; Ellis et al. 1991).

  As urban areas have encroached on military bases and the nature of missions changed, the DOD has actively sought to expand reservations where it has demonstrated need. While unconfirmed, there is speculation that DOD would like to acquire BLM lands adjacent to Dugway Proving Ground, UT (Bauman 2004). DOD has also objected to the development of wind turbines near its holdings due to the structures interference with radar and flight operations (Danelski 2010).

  Military protocol restricts some information about CAs and sometimes CEs on installations. This has developed gaps in knowledge about those portions of the Central Basin landscape. While some areas have been accessed by researchers and military land use designations and species information have been made public through bases' Natural Resource Management Plans. The FAA has information about military no-fly zones, low flying areas and flight paths. Treatment of military reservations and on and offsite activities is complex and makes this a special case CA. We recommend continuing the investigation of the CA through Task 2 data evaluation but it will require greater clarity and data availability to be given adequate treatment in the assessment.
- Air quality impacts (non attainment areas and dust): Air quality is an outcome of land use impacts where plume/deposition areas are mapped or can be modeled. Much like water quality there are point sources (e.g., power plants) and diffuse sources of air pollution such as generalized land disturbance and automobiles. Air quality impacts can be classified into fugitive dust (from construction, mines, ORV use, dewatered lakes) or urban pollution (from automobiles, industrial facilities). Not uncommonly the two combine to increase impacts to air quality. Dust from Owens (dry) lake has locally affected human health (Reheis 1997) and

increasingly dust has been implicated in the premature snow melt in mountains near impacted areas (Painter et al. 2007).

- Recreation (OHV use, other intensive recreation, land sales, etc.): Although a desirable land use in the proper setting, recreation, especially OHV use can have significant impacts such as land cover and soil disruption, spread of invasive species, noise pollution causing habitat abandonment, etc.
- Refuse Management (landfills, sewage sludge disposal, nuclear disposal, etc.): This CA can impact CEs through habitat removal or alteration (e.g., hydrologic, fertilization, erosion, dust). It also can have detrimental effect on bird populations through contaminants in food, and affect aquatic life through contamination of ground and surface waters (Lee and Jones-Lee 2010).
- Agriculture: this CA was not identified in the original SOW so we propose two subclasses for consideration.
    - Agricultural (crop, orchards, irrigated pasture)- High intensity agricultural is a source of non-point and source pollution, direct toxicity (via herbicides and pesticides) that negatively affects air and water quality, and wildlife habitat and reproductive success (Nachlinger et al. 2001, WAPT 2006).
    - Exotic ungulate grazing—Much of the Central Basin was subjected to very high stocking rates at the turn of the last century. Today, while many lands are improving, there are still areas where exotic ungulate grazing occurs at stocking rates that stress ecosystems. In some valleys, exotic ungulate (e.g. cattle, sheep, wild horses, and burros) impact the same riparian areas and springs. Exotic ungulate grazing impacts include (but are not limited to) trampling and removal of vegetation, destruction of biological soil crusts (which harbor algae, moss and lichen biodiversity), erosion of stream banks, decrease in water quality, widening of streams, increases in water temperatures, allows for terrestrial native and non-native increasers, and aquatic invasives, changes in fish species composition and the reduction in vigor of understory shrubs and herbs in montane pine forests (Chambers and Miller 2004, Medina and Marin 1988, WAPT 2006). Exotic ungulate grazing pressure can work synergistically with other CAs such as changes in climate, fire regimes and off road recreation. Without assessing the level of pressure exotic ungulate grazing exhibits on Central Basins CEs, it will be difficult to access CE resilience and resistance to other stressors such as climate change impacts.

Class III Invasive Species

An invasive species is a non-native plant or animal species whose presence is likely to cause ecological or economic harm, outweighing any potential benefits. Here we describe the subclasses of terrestrial and aquatic invasives.

- Terrestrial Invasive Species (TIS) are a primary concern in this the Central Basins ecoregion. Loss of native species richness and abundance may reduce ecosystem resilience and the capacity to adjust to ever-increasing rates of environmental change (Chapin et al. 1997). Major invasive plant species that affect of crowding out many native species include dry land species Cheatgrass, Halogeton, Medusa head, Tumble Mustard, Russian Thistle and Knapweed (Nachlinger et al. 2001). Additionally, several terrestrial invertebrates and vertebrates are present which threaten native species/systems and multiple food crops. Some TIS may alter ecological system function; for example, as seen with cheatgrass (*Bromus tectorum*) and changes in fire regime – shifting diverse shrub steppe to low-diversity annual grassland systems (Wisdom et al. 2006). Some ecosystems face conversion to TIS monocultures as experienced along western riparian systems where the deep taproots of the salt cedar (*Tamarix* sp.) and

Russian Olive (*Eleagnus angustifolia*) can stress native riparian trees and shrubs when coupled with increased alkalinity of stream flow through agricultural runoff, and altered hydrologic flow from dams and water diversions that can have cascading affects on native vertebrates such as amphibians and some songbirds (Stromberg et al. 2009, Chambers and Miller 2004).

- Aquatic Invasive Species (AIS) include invasive species and aquatic viral, bacterial, and other pathogenic and parasitic organisms at multiple trophic levels that impact primary and secondary productivity and lead to competitive exclusion, predation, indirect effects, trophic cascades, etc. For example, the New Zealand mudsnail (*Potamopyrgus antipodarum*) can sequester a large fraction of available carbon away from native invertebrate production and drastically alter food web function (Hall et al. 2006). Zebra and quagga mussels (*Dreissena* sp.), the latter of which has become established in the West, are well known for their negative impacts on natural ecosystems. In the last several years, a native diatom, *Didymosphenia gemenata* has blossomed into a nuisance species throughout portions of the U.S., and has drastically reduced native aquatic biodiversity and even altered stream hydraulics (Spaulding and Elwell 2007). The list of aquatic invasive species in the West is large and increasing, including; amphibians (e.g., bullfrog), fish (e.g., gizzard shad, several Asian carp species, northern snakehead, etc.), viruses and pathogens (e.g., whirling disease, West Nile virus), crustaceans (e.g., rusty crayfish), and mollusks (e.g., Asiatic clam). We propose to limit our efforts in this rapid ecoregional assessment to the aquatic invasive/nuisance taxa including the diatom, *Didymosphenia gemenata* (Didymo, rock snot), the Gastropods *Pomacea* sp.(apple snails), *Radix auricularia,* (European ear snail*), Melanoides tuberculatus* (Red-rim melania), *Potamopyrgus antipodarum (*New Zealand mudsnail), and *Cipangopaludina chinensis malleata* (Chinese mystery snail); Bivalves (clams) *Corbicula fluminea* and *Dreissena* sp.; several taxa of exotic crayfish, the African clawed frog (*Xenopus laevis*), and fishes: Mollies and Guppies (*Poecilia* sp.), Tilapia (*Oreochromis* sp,), Asian or European carp (Family *Cyprinidae*). These candidate taxa were selected based on: 1) magnitude of their known or perceived future impacts, 2) need to encompass a full spectrum of various aquatic habitat and trophic level effects, 3) likelihood of their spread, 4) sensitivity of native taxa, and 5) their adaptability to CAs, particularly climate change (e.g., increased water temps, decreased amounts of surface flow water, increased solar radiation, etc.).

Class IV Climate Change

Climate change stress across the Central Basin and Range is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts. BLM lands could be especially susceptible to synergistic interactions between current stress from land use practices and climate change. Species' ability to shift their ranges in response to climate changes could also be negatively impacted by barrier-forming activities on BLM lands. As climate change progresses, many species will disperse to new areas as historic habitat becomes inhospitable. Land use practices, such as road building, energy extraction, ORV use, recreation, alternative energy development, and others, are likely to reduce the connectivity of habitat and corridors for movement, thereby reducing dispersal success. Many of these actions also result in habitat loss, disturbance, soil erosion, and sedimentation, causing further stress to aquatic and terrestrial species as they are impacted by climate change.

Wildfire has already increased six-fold across the western U.S. (Westerling et al. 2006) and is expected to continue to increase with climate change. Wildfire is expected to act synergistically with climate change to speed vegetation transformations across the west (shifts from one dominant type to a different dominant type of vegetation). Two key subclass CAs, temperature change and precipitation change, are also being used by NDOW to assess species vulnerability to climate change:

- **Temperature Change-** Average annual temperature in the Central Basin is expected to increase 5-6 degrees F. Average summer (June-August) temperature is expected to increase 5.8-6.7 degrees F while average winter (December-February) temperature will increase 4.2-5.0 degrees F (Maurer et al. 2007) (See **Error! Reference source not found.**).Temperature change is expected to lead to range shifts among plants, animals, and other living things (Parmesan and Yohe 2003). Many species that are unable to disperse to new areas may decline in number due to unfavorable conditions (Thomas et al. 2004), leading to local extirpations or range-wide extinctions.

  Increased evaporation and transpiration from higher temperatures will lead to declining soil moisture and increased drought stress in plants, unless offset by substantial increase in precipitation (Dale et al. 2001). Drought stress could lead to loss of native vegetation from fire and insect infestation. Especially at risk are subalpine forests, which are found at higher elevations (USGCRP 2009).

  Invasive species are expected to increase as native species decline, allowing non-native grasses like cheatgrass, red brome and buffle grasses to invade desert and shrub ecosystems. These new grasses can fuel fires in systems that are not adapted to fire, causing further decline among native desert species (USGCRP 2009, Smith et al. 2000).

  Temperature change is expected to have a greater impact than precipitation change on stream flow (He et al. in review), as lower snowpack and earlier snowmelt will both lead to changes in hydrological patterns. Warmer water and lower summer flows are both expected in regional rivers and streams, potentially affecting aquatic species.

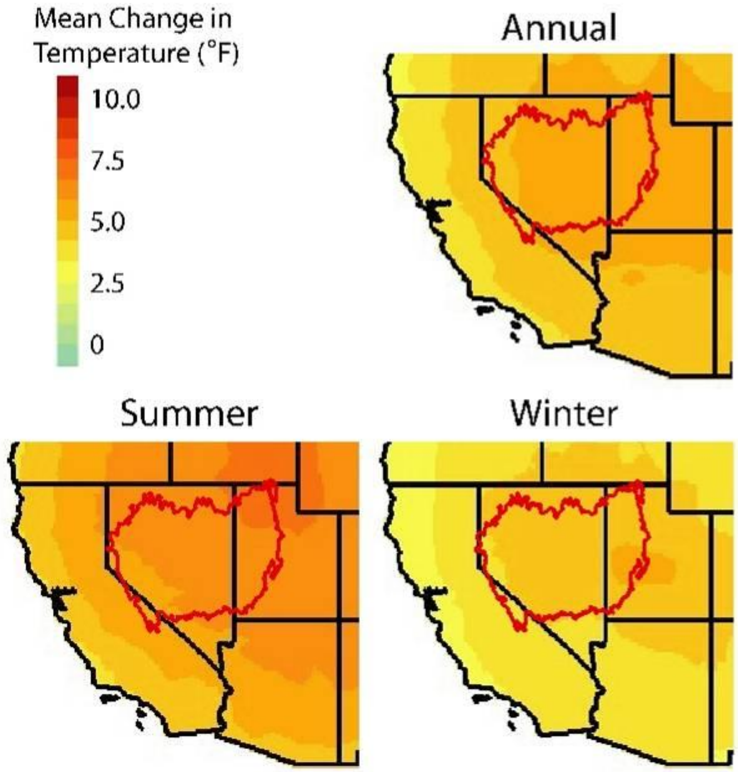

Figure 8. Temperature in the Central Basin, change from historic (1961-1990) to mid-century (2040-69) (Maurer et al. 2007)

- **Precipitation Change**: Annual average precipitation change in the Central Basin will vary from -8% to +13%. Summer precipitation is forecast to plummet in the northern basin (-25%) while increasing (+8.3%) near the Mojave Basin. As an average, winter projections are slightly wetter varying from +4.2% to +16.7% (Maurer et al. 2007) (See **Error! Reference source not found.**). Precipitation change projections are highly variable, making it difficult to identify specific ecological effects. The Southwest is expected to become drier, however, even with some seasonal increases in precipitation, due to increased evaporation and loss of snowpack (USGCRP 2009; Lenart et al. 2007, Seager et al. 2007). Longer, more severe, and more frequent drought events are expected (USGCRP 2009; Lenart et al. 2007, Seager et al. 2007).

  At middle elevations, precipitation is expected to increasingly fall as rain instead of snow, which will result in faster runoff earlier in the spring. Rain on snow events could become more common, leading to sudden influx of water into streams and rivers, possibly causing more floods. Aquifers could receive less recharge due to sudden runoff events rather than slowly melting snow.

  With a warmer atmosphere (able to hold more water) and intensified water cycle, there is an additional increased likelihood of flooding (Lenart et al. 2007). Flooding can lead to greater sedimentation input to streams, causing declines water quality for both people and aquatic organisms. Increases in wildfire and declines in native vegetation will exacerbate this problem due to declining soil stability.

Many species will need to shift to new areas with more suitable precipitation patterns in order to persist. Due to the mountainous terrain and land use, however, dispersal corridors allowing many species to move may be unavailable.

Desert bighorn sheep reproduction is especially sensitive to precipitation. Desert bighorn sheep are already declining in the Southwest due to drought and could continue to decline as climate change progresses (Epps et al. 2004). Pinyon pine has shown high susceptibility to climate change impacts in the Four Corners region of the western U.S. (Breshears et al. 2009). The Central Basin and Range ecoregion also has substantial coverage of pinyon pine, which may be sensitive to drought brought on by climate change. An AMT workshop 1 participant indicated that they are already witnessing sustained declines in pinyon obligate species such as pinyon jay that appears to be linked with climate change effects.

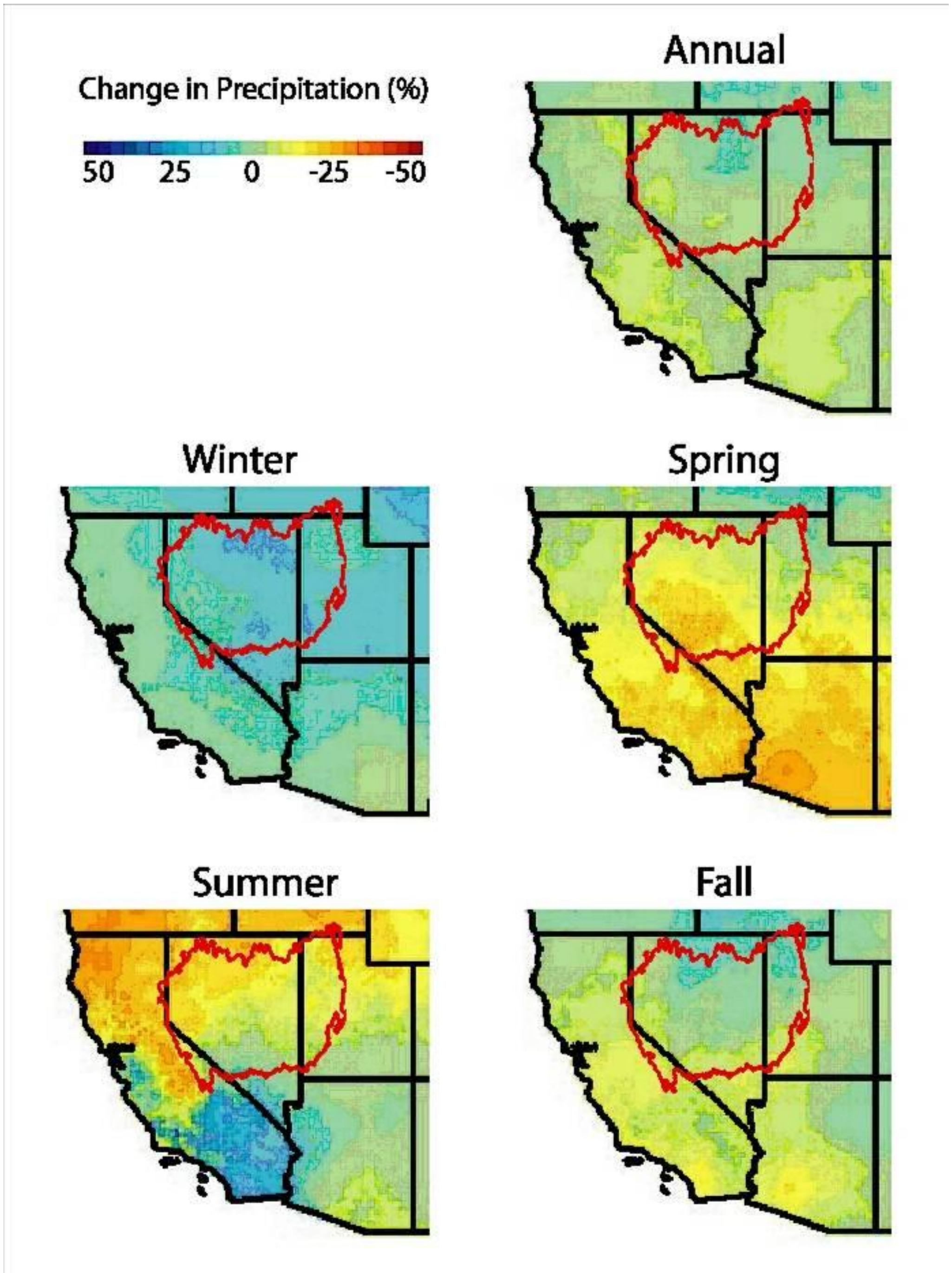

Figure 9. Precipitation in the Central Basin, change from historic (1961-1990) to mid-century (2040-69) (Maurer et al. 2007)

Assessment Process

A review of literature was conducted pertinent to CAs and their effects on conservation elements. Emphasis was placed on studies and reports regarding the Central Basin & Range ecoregion to assess ecoregionally specific impacts such as invasive species. However, some information was gathered from areas outside of the ecoregion with similar ecological processes (e.g. Sonoran ecoregional plan) when regionally specific information was not available or effects were more universal (e.g. landfill impact on groundwater). This literature was used to assess if the CA is currently a significant impact (in some cases historical, but the impact remains), if it will remain an impact in the future, or if not currently present, it's potential to occur in the ecoregion in the future.

Climate change was assessed using literature review and ClimateWizard, an online climate change query tool (www.climatewizard.org). ClimateWizard can be run with user-defined boundaries so the tool was used to evaluate climate change at the ecoregion level. The evaluations used an ensemble of 16 atmosphere-ocean general circulation models (GCMs) based on the "High A2" emission scenario. The base climate projections are downscaled from the work of Maurer *et al.* (2007). The AMT recommends that BLM make an effort to coordinate scenario selection with state fish and wildlife agencies many of which are currently updating their WAPs to include climate change effects.

Change Agent Assessment Table

Greater detail of the assessment is provided in the table in Appendix3. Definition of fields follow:

1. Change agent name/type: A hierarchical list of change agents evaluated by the team
2. Source: This field will list sources consulted in the characterization and evaluation of the CA.
3. Ecological effects: In general terms, the ecological effects documented by sources.
4. Conservation elements affected: What are the CEs that are affected by the CA? This is not an exhaustive list but draws opportunistically from literature and from the experience of the team members.
5. Effects Conservation elements: How are the CEs affected? As above, not an exhaustive list
6. Key CA synergies: Identifies strong synergies that cause the CA to occur or intensify in the presence of another CA.
7. Current: Identifies if the CA is currently occurring in the ecoregion (subject to further data analysis)
8. Future: Identifies if the CA is forecast to occur (but is not occurring currently) (subject to further data analysis and possible modeling)
9. Include: Can be used by the AMT to evaluate the inclusion of the CA in the subsequent project tasks and to document final decisions of the AMT subject to later filters of data evaluation.

Summary of Key Sources Consulted

- The Nature Conservancy's Great Basin Ecoregional Plan (Nachlinger et al. 2001)
- The Nevada State Wildlife Action Plan (WAPT 2006)
- The California State Wildlife Action Plan (Bunn *et al.* 2007)
- Peer review scientific literature (journals included Science, American Naturalist, Great Basin Naturalist, Conservation Biology, and others), published books such as Road Ecology (Forman et al. 2004) and Great Basin Riparian Ecosystems (Chambers and Miller2004) and government web sites (EPA, BLM, and others).
- Interviews with Natural Heritage Ecologists (Janel Johnson, wetland ecologist, Nevada)

Summary of Change Agent Recommendations

1. We found the list of candidate CAs provided by the AMT to be highly relevant and recommend inclusion of all for further assessment for data availability and quality. We also recommend

adding agriculture (crops and exotic ungulate grazing), alterations to surface water hydrology, as these changes strongly affect fish and other aquatic and riparian CEs. We recommend the addition of exotic ungulate grazing as a CA. While we recognize the difficulty in ecoregional wide consistent data on exotic ungulate grazing, this CA has important synergistic effects with other CAs and would (if feasible) inform the current status and condition of CEs.

2. There are distinct differences between armed service branches regarding the impacts and management questions will be different. The positive benefits of military reservation need to be considered as well. Some military uses have clear impacts to CEs (motorized and artillery maneuvers) while other uses' impacts may not be clear cut (low flying aircraft). *Areas of moratorium on land use planning* may apply to several recent trends: military objections to the placement of wind turbines near bases and the planned expansion of several bases. Spatial information on natural resources and management is available through individual base's Natural Resource Management Plans. Military no-fly areas, low fly areas and flight paths are readily available through the FAA. Likewise potential *military-use expansion* represents a realistic CA but there is uncertainty about what impacts military expansion entails. Atmospheric deposition was added in the Air and Water Quality category to address the impacts of acidification of soil, aquatic systems and root dynamics, nutrient enrichment, and mercury contamination.
3. The original invasive species list was edited to reflect those having the greatest impact to the Central Basin and Range. The following species were added to the AMT provided list:
   For CB We documented these additional specific TES:
   - Medusa Head (Taeniantherum caput-medusae)
   - Russian Olive (Elaeagnus angustifolia)
   - Halogeton (Halogeton glomeratus)
   - Tumble mustard (Sisymbrium altissimum)
   - Russian thistle (Salsola kali)
   - Hardheads or Russian Knapweed (Acroptilon spp.)
   - Other Knapweeds (Centaurea spp.)
   - Nasturtiumm officinale
   - non-native thistles

   And more specific Aquatic invasives:
   - Didymosphenia gemenata (Didymo, rock snot)
   - Apple snails (Pomacea sp.)
   - European Ear Snail (Radix auricularia)
   - Red-rim melania (Melanoides tuberculatus)
   - New Zealand mudsnail (Potamopyrus antipodarum)
   - Chinese mystery snail (Cipangopaludina chinensis malleata)
   - African clawed frog (Xenopus laevis)
   - Crayfish sp.
   - Mollies and guppies (Poecilia sp.)
   - Tilapia (Oreochromis sp)
   - Gizzard shad
   - Asian or European carp (Family Cyprinidae)
   - Bull frog (Rana catesbeiana)
   - Quagga Mussel (Dreissena rostriformis bugensis)
   - Zebra Mussel (Dreissena polymorpha)

Recommendations for Future Research

We anticipate most recommendations to be additive as we filter the CE and CA candidates through the following data assessment and proposed modeling with AMT review and input. Several items are likely to drop out as infeasible in the REA. In this Task we identified the following recommendations for future research:

1. Assess BLM's process and capacity for conducting inventory and monitoring of CEs and CAs across the ecoregion.
2. A considerable breadth of empirical research is likely needed to understand the effects of particular CAs on specific CEs.

References

Adams, J.C. and S.F. McCool. 2009. Finite recreation opportunities: the Forest Service, the Bureau of Land Management, and Off-road Vehicle Management. Natural Resources Journal 49: 45-116.

Arizona Game and Fish Department (AZ GFD). 2006. DRAFT. Arizona's Comprehensive Wildlife Conservation Strategy: 2005-2015. Arizona Game and Fish Department, Phoenix, Arizona.

Artz, M. C. 1989. Impacts of linear corridors on perennial vegetation in the East Mojave Desert: implications for environmental management and planning. *Natural Areas Journal* 9:117–129.

Baechler, M. C., and A. D. Lee. 1991. Implications of environmental externalities assessments for solar thermal power plants. Pages 151-158 in T. R. Mancini K. Watanabe and D. E. Klett, eds. Solar Engineering 1991. American Society of Mechanical Engineering, New York.

Barrios, L. & Rodriguez, A. 2004. Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. J. Appl. Ecol. 41: 72–81.

Bates, J. William and Miles O. Moretti. 1994. Golden Eagle *(Aquila chrysaetos)* Population Ecology in Eastern Utah. Great Basin Naturalist 54(3) pp. 248-255

Bauman, J. 2004. Is Dugway's expansion an alien concept? Deseret News, Salt Lake City, UT. Nov. 4, 2004 http://www.deseretnews.com/article/1,5143,595102911,00.html?pg=3

Beamish, R. 2009. Desert Clash in West Over Solar Potential, Water. U.S. News & World Report. April 18, 2009.

Beever, Erik A. and Peter F. Brussard. 2000. Examing Ecological Consequences of Feral Horse Grazing using Exclosures. Great Basin Naturalist. 60(3) pp. 236-254.

Belsky, A. J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation 54(1): 419-431.

Benson, A. J.. 2010. *Melanoides tuberculatus*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=1037 RevisionDate: 4/24/2006

Berger, Joel. 1985. Interspecific Interactions and Dominance Among Wild Great Basin Ungulates. J. Mamm. 66(3):571-573

Blank RR, JA Young, FL Allen. 1999. Aeolian dust in a saline playa environment, Nevada, USA. J Arid Environ 4: 365–81.

Breshears, D., Orrin B Myers, Clifton W Meyer, Fairley J Barnes, Chris B Zou, Craig D Allen, Nathan G McDowell, and William T Pockman. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the National Academy of Sciences (USA) 102:15144–15148.

Breshears, David D, Orrin B Myers, Clifton W Meyer, Fairley J Barnes, Chris B Zou, Craig D Allen, Nathan G McDowell, and William T Pockman. 2009. Tree die-off in response to global change-type drought: mortality insights from a decade of plant water potential measurements. Frontiers in Ecology and the Environment. 7:185-189.

Bureau of Land Management (BLM). 2004. Santa Rosa and Santa Jacinto National Mountains Final Management Plan and Record of Decision. Accessed May 2009 at http://www.blm.gov/ca/st/en/fo/palmsprings/santarosa/management_plan.html

Bureau of Land Management (BLM). 2008. Grand Canyon-Parashant National Monument Record Of Decision and Approved Resource Management Plan. Accessed May 2009 at http://www.blm.gov/az/st/en/info/nepa/environmental_library/arizona_resource_management/gcp_ROD.html

Bureau of Land Management (BLM). 2009. Secretary Salazar, Senator Reid Announce 'Fast-Track' Initiatives for Solar Energy Development on Western Lands. Bureau of Land Management Press Release, 06/29/09. http://www.doi.gov/news/pressreleases/2009_06_29_release.cfm

Bureau of Land Management (BLM California). 2010. Biomass. Downloaded from http://www.blm.gov/ca/st/en/prog/energy/biomass.html

Bureau of Land Management (BLM Nevada). 2010. Fast-Track Renewable Energy Projects. Bureau of Land Management Nevada State Office http://www.blm.gov/nv/st/en/prog/energy/fast-track_renewable.html

Bureau of Land Management (BLM). 2010. Record of Decision Ruby Pipeline. News Release No. 2010-023. http://www.blm.gov/nv/st/en/info/newsroom/2010/july/record_of_decision.html

Breshears, D., Orrin B Myers, Clifton W Meyer, Fairley J Barnes, Chris B Zou, Craig D Allen, Nathan G McDowell, and William T Pockman. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the National Academy of Sciences (USA) 102:15144–15148.

Breshears, David D, Orrin B Myers, Clifton W Meyer, Fairley J Barnes, Chris B Zou, Craig D Allen, Nathan G McDowell, and William T Pockman. 2009. Tree die-off in response to global change-type drought: mortality insights from a decade of plant water potential measurements. Frontiers in Ecology and the Environment. 7:185-189.

Bunn, David, Andrea Mummert, Marc Hoshovsky, Kirsten Gilardi, and Sandra Shanks. 2007. California Wildlife: Conservation Challenges. California's Wildlife Action Plan. Prepared by the UC Davis Wildlife Health Center, Davis, CA for the California Department of Fish and Game, Sacramento, CA. 597 pp.

Caro TM, O'Doherty G. 1999. On the use of surrogate species in conservation biology. Conservation Biology 13: 805–814.

Carroll C, Noss RF, Paquet PC. 2001. Carnivores as focal species for conservation planning in the Rocky Mountain region. Ecological Applications 11: 961–980.

CEC, 2010. Geothermal Energy in California. California Environmental Commission. http://www.energy.ca.gov/geothermal/

Chambers, JC. J R Miller eds. 2004. Great Basin Riparain Ecosystems. Island Press, Washington D.C., 303 pp.

Chapin III, F. Stuart, Brian H. Walker, Richard J. Hobbs, David U. Hooper, John H. Lawton, Osvaldo E. Sala, and David Tilman. 1997. ***Science*** 25 277: 500-504

Chung-MacCoubrey, A. L., R. E. Truitt, C. C. Caudill, T. J. Rodhouse, K. M. Irvine, J. R. Siderius, and V. K. Chang. 2008. Mojave Desert Network vital signs monitoring plan. NPS/MOJN/NRR—2008/057. National Park Service, Fort Collins, Colorado.

Cole K., K. Ironside, J. Eischeid, G. Garfin, 2009. Title: Past and ongoing shifts in Joshua tree support future modeled range contraction, In Press.

Comer, P., and K. Schulz. 2007. Standardized Ecological Classification for Meso-Scale Mapping in Southwest United States. Rangeland Ecology and Management 60 (3) 324-335.

Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. Ecological Systems of the United States: A Working Classification of U.S. Terrestrial Systems. NatureServe, Arlington, VA.

Comer, P.J., & J. Hak. 2009. NatureServe Landscape Condition Model. Internal documentation for NatureServe Vista decision support software engineering, prepared by NatureServe, Boulder CO.
Commission for Environmental Cooperation. 1997. Ecological regions of North America: toward a common perspective. Commission for Environmental Cooperation, Montreal, Quebec, Canada. 71pp. Map (scale 1:12,500,000).
Coppolillo P, Gomez H, Maisels F, Wallace R. 2004. Selection criteria for suites of landscape species as a basis for site-based conservation. Biological Conservation 115: 419–430.
Courtney, P. A. and M. B. Fenton. 1976. The Effects of a Small Rural Garbage Dump on Populations of Peromyscus leucopus Rafinesque and Other Small Mammals. Journal of Applied Ecology, Vol. 13, No. 2 pp. 413-422
Cress, J., R. Sayre, P. Comer, and H. Warner. 2008. Terrestrial Ecosystems – Bioclimate. U.S. Geological Survey. Scale 1:7,000,000.
Dale, Virginia H., Linda A. Joyce, Steve McNulty, Ronald P. Neilson, Matthew P. Ayres, Michael D. Flannigan, Paul J. Hanson, Lloyd C. Irland, Ariel E. Lugo, Chris J. Peterson, Daniel Simberloff, Frederick J. Swanson, Brian J. Stocks, And B. Michael Wotton. 2001. Climate Change and Forest Disturbances. BioScience 51:723-734.
Danelski, D. 2010. Wind farms could interfere with flight patterns, radar systems, military says. The Press Enterprise. Riverside, CA. September 18, 2008 http://www.pe.com/localnews/stories/PE_News_Local_D_wind01.1d3f22e.html
Deacon, James E., Austin E. Williams, Cindy Deacon Williams, and Jack E. Williams. 2007. Fueling Population Growth in Las Vegas: How Large-scale Groundwater Withdrawal Could Burn Regional Biodiversity. BioScience 57(8):688-698.
Demarais, S., D.J.Tazik, P.J. Guertin, E.E. Jorgensen. 1999. Distrubance Associated with Military Exercises. Pages 385-396 in LR Walker (Ed) Ecosystems of disturbed ground. Elsevier Science, New York.
Drewitt, A.L. & R.H.W. Langston. 2006. Assessing the impacts of wind farms on birds. Ibis 148: 29–42.
Ellis, D. H., C. H. Ellis and D. P. Mindell. 1991. Raptor responses to low-level jet aircraft and sonic booms. Environ. Pollut. 74:53-83.
Enserink, M. 1999. Biological invaders sweep in. Science. 285(5435): 1834-1836.
Environmental Protection Agency (EPA; Bierwagen, B., D.M. Theobald, C.R. Pyke, A. Choate, P. Groth, J.V. Thomas, and P. Morefield). 2009 *Land-Use Scenarios: National-Scale Housing-Density Scenarios Consistent with Climate Change Storylines*. Global Change Research Program, National Center for Environmental Assessment, Washington, DC; EPA/600/R-08/076F. URL: http://www.epa.gov/ncea.
Environmental Systems Research Institute. 2008. ArcGIS 1999-2008.
Epps, C. W., D. McCullough, J. D. Wehausen, V. C. Bleich, and J. L. Rechel. 2004. Effects of climate change on population persistence of desert-dwelling mountain sheep in California. Conservation Biology 18:102-113.
Erman, N.A. 2002. Lessons from a long-term study of springs and spring invertebrates (Sierra Nevada, California, USA) and implications for conservation and management. In: Sada D.W., Sharpe, S.E., editors; 2002; Las Vegas, NV.
Fenn, ME., R Haeuber, G. Tonnesen, J. Baron, S. Grossman-Clarke, D. Hope, DA. Jaffe, S Copland, L Geiser, HM. Rueth, JO. Sickman. 2003. Nitrogen Emissions, Deposition, and Monitoring in the Western United States. BioScience 2003 53:4, 391-403
Fiero, W. 1986. Geology of the Great Basin. University of Nevada Press, Reno, NV. 356 pp.
Fleishman, E., R.B. Blair, and D.D. Murphy (2001). Empirical validation of a method for umbrella species selection. Ecological Applications 11(5): 1489-1501.

Flint, L.E., and A.L. Flint. 2007. Regional analysis of groundwater recharge, IN Stonestrom, D.A., J. Constantz, T.P.A. Ferre, and S.A. Leake (eds.). Groundwater recharge in the arid and semi-arid southwestern United States: U.S. Geological Survey Professional Paper 1701, p. 29-59.

Forman, Richard, Daniel Sperling, John Bissonette, Anthony Clevenger, Carol Cutshall, Virginia Dale, Lenore Fahrig, Robert France, Charles Goldman, Kevin Heanue, Julia Jones, Frederick Swanson, Thomas Turrentine, Thomas Winter. 2004. Road Ecology: Science and Solutions. Island Press, Washington D.C., 481 pp.

Franklin, J. F. (1993). Preserving biodiversity: Species, Ecosystems, or Landscapes? Ecological Applications 3: 202-205.

GAO, 1994. "Is Military Research Hazardous to Veterans Health? Lessons Spanning Half A Century" 103rd Congress, 2nd Session-S. Prt. 103-97; Staff Report prepared for the committee on veterans' affairs, December 8, 1994, John D. Rockefeller IV, West Virginia, Chairman

Grayson, D.K. 1993. The desert's past: a natural prehistory of the Great Basin. Smithsonian. Institution Press, Washington, DC. 356 pp

Gross, John E. 2005. Developing Conceptual Models for Monitoring Programs. National Park Service, Inventory and Monitoring Program, Fort Collins, CO. (http://science.nature.nps.gov/im/monitor/docs/Conceptual_Modelling.pdf).

Groves, C. R. 2003. Drafting a Conservation Blueprint: A Practitioner's Guide to Planning for Biodiversity. Island Press, Washington, DC.

Groves, C. R., D. B. Jensen, L. L. Valutis, K. H. Redford, M. L. Shaffer, J. M. Scott, J.V. Baumgartner, J. V. Higgins, M. W. Beck and M. G. Anderson. 2002. Planning for biodiversity conservation: Putting conservation science into practice. BioScience 52:499-512.

Hageman,KJ., S.L. Simonich, DH. Campbell, GR Wilson, DH. Landers. 2006.Atmospheric Deposition of Current-Use and Historic-Use Pesticides in Snow at National Parks in the Western United States Environmental Science & Technology 2006 40 (10), 3174-3180

Hall, R. O., M. F. Dybdahl, and M. C. VanderLoop. 2006. Extremely high secondary production of introduced snails in rivers. Ecological Applications. 16 (3): 1121-1131.

Hansen, A.J., R.L. Knight, J.M. Marzluff, S. Powell, K. Brown, P.H. Gude and K. Jones. 2005. Impacts of exurban development on biodiversity: patterns, mechanisms, and research needs. Ecological Applications 15: 1893-1905.

He, Zili, Zhi Wang, C. John Suen, and Xiaoyi Ma. In Review. Climate change impacts on water availability in the Upper San Joaquin River watershed, California. http://www.csufresno.edu/ees/Faculty&Staff/Wang/CV_Zhi_Wang.pdf

Hershler, R. and D. W. Sada. 2002. Biogeography of Great Basin aquatic snails of the genus Pyrgulopsis. Smithsonian Contributions to the Earth Sciences 33:255-276.

Hidy, G.M. and H.E. Klieforth. 1990. Atmospheric processes affecting the climate of the Great Basin. Pages 17-46, in: C.B. Osmond, L.F. Pitelka, and G.M. Hidy, editors. Plant biology of the Basin and Range. Springer-Verlag, New York, NY. 375 pp.

Hunter, M. L. 1990. Wildlife, forests, and forestry: principles of managing forests for biological diversity. Englewood Cliffs, NJ, Prentice Hall.

Hunter, R., F.B. Turner, R.G. Lindberg, K. Bell Hunter. 1987. Effects of Land Clearing on Bordering Winter Annual Populations in the Mohave Desert. Great Basin Naturalist 47: 234-238

Ingelfinger, Franz and Stanley Anderson. 2004. Passerine Response To Roads Associated With Natural Gas Extraction In A Sagebrush Steppe Habitat. Western North American Naturalist 64(3) pp. 385–395

Ito, Takehiko Y; N. Miura, B.Lhagvasuren, D. Enkhbileg, S. Takatsuki, A. Tsunekawa and Z. Jiang. 2005 Preliminary Evidence of Barrier Effect of a Railroad on the Migration of Mongolian Gazelles. Conservation Biology Vol 19 No 3 945-948

Jenkins, R. E. 1976. Maintenance of natural diversity: approach and recommendations. In: K. Sabol (ed.) Transactions–Forty -first North American Wildlife and Natural Resources Conference. Washington, D. C. March 21-25, 1976. Pp. 441-451.

Johansen, Jeffery R. and Larry St. Clair. 1986. Cryptogamic Soil Crusts: Recovery from Grazing Near Camp Floyd State Park, Utah. The Great Basin Naturalist Vol 45, No 4 pp 632-640.

Kintsch, J. A. and D. L. Urban. 2002. Focal species, community representation, and physical proxies as conservation strategies: a case study in the Amphibolite Mountains, North Carolina, U.S.A. Conservation Biology 16:936-947.

Knapp, PA. 1992. Soil Loosening Process following the Abandonment of Two Arid Western Nevada Townsites. Great Basin Naturalist 52(2), pp. 149-154

Krausman, P.R., M.C. Wallace, C.L. Hayes, D.W. DeYoung. 1998. Effects of Jet Aircraft on Mountain Sheep. The Journal of Wildlife Management, Vol. 62, No. 4, pp. 1246-1254

Lambeck RJ. 1997. Focal species: A multi-species umbrella for nature conservation. Conservation Biology 11: 849–856.

LANDFIRE National Vegetation Dynamics Models. (2007, January - last update). [Homepage of the LANDFIRE Project, U.S. Department of Agriculture, Forest Service; U.S. Department of Interior], [Online]. Available: <http://www.landfire.gov/index.php> [2007, February 8].

Lawler, J. J., D. White, J. C. Sifneos and L. L. Master. 2003. Rare species and the use of indicator groups for conservation planning. Conservation Biology 17:875-882.

Lee, G. F., and Jones-Lee, A. 2005 "Municipal Solid Waste Landfills – Water Quality Issues" *IN:* Water Encyclopedia: Water Quality and Resource Development, Wiley, Hoboken, NJ. pp 163-169.

Lee G.F. and A. Jones-Lee. 2010. Flawed Technology of Landfill of Municipal Solid Waste. http://www.gfredlee.com/Landfills/SubtitleDFlawedTechnPap.pdf

Lenart, M., G. Garfin, B. Colby, T. Swetnam, B. J. Morehouse, S. Doster, and H. Hartmann. 2007. Global Warming in the Southwest: Projections, Observations, and Impacts. The Climate Assessment Project for the Southwest (CLIMAS). Institute for the Study of Planet Earth. The University of Arizona. Tucson, AZ.

Leu, M., S.E. Hanser, and S.T. Knick. 2008. The human footprint in the West: A large-scale analysis of anthropogenic impacts. Ecological Applications 18(5): 1119-1139

Lovich JE., D. Bainbridge. 1999. Anthropogenic Degradation of the Southern California Desert Ecosystem and Prospects for Natural Recovery and Restoration. Environmental Management Volume 24, Number 3, 309-326

Major, Richard E. and Holly Parsons. 2010. What do museum specimens tell us about the impact of urbanisation? A comparison of the recent and historical bird communities of Sydney. Emu 110(1) 92-103.

Margules, C. R. and R. L. Pressey. 2000. Systematic conservation planning. Nature 405: 243- 253.

Martin, J., M.C. Runge, J.D. Nichols, B.C. Lubow, and W.L. Kendall. 2009. Structured decision making as a conceptual framework to identify thresholds for conservation and management. Ecological Applications 19(5): 1079-1090.

Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy. 2007. Fine-resolution climate projections enhance regional climate change impact studies, ***Eos Trans. AGU***, 88(47), 504

McNab, W.H.; Cleland, D.T.; Freeouf, J.A.; Keys, Jr., J.E.; Nowacki, G.J.; Carpenter, C.A., comps. 2007. Description of ecological subregions: sections of the conterminous United States [CD-ROM]. Gen. Tech. Report WO-76B. Washington, DC: U.S. Department of Agriculture, Forest Service. 80 pp.

Medina, A. A C Martin. 1988 Stream Channel and Vegetation Chagnes in section of McKnight Creek, New Mexico. Great Basin Naturalist Vol 48, No 3 pp 373-381

Mihlmester P. E., J. B. Thomasian, M. R. Riches. 1980. Environmental and health safety issues. Pages 731-762 in W. C. Dickinson and P. N. Cheremisinoff. eds. Solar Energy Technology Handbook. Marcel Dekker, New York

Milchunas, D.G, K.A. Schulz, R.B. Shaw. 2000. Plant community structure in relation to long-term distrubance by mechanized military maneuvers in a semiarid region. Environ. Manage. 25:525-539

Miller, M.E., 2005, The Structure and Functioning of Dryland Ecosystems—Conceptual Models to Inform Long-Term Ecological Monitoring: U.S. Geological Survey Scientific Investigations Report 2005-5197, 73 pp.

Moritz, C. James L. Patton, Chris J. Conroy, Juan L. Parra, Gary C. White, Steven R. Beissinger. 2008. Impact of a Century of Climate Change on Small-Mammal Communities in Yosemite National Park, USA. Science, Vol 322: 261-264.

Morrison, M.; Fox, S. 2009. Bats associated with inactive mines in the Great Basin. Western North American Naturalist, Vol 69, No 1. 6912

Nachlinger, J., K. Sochi, P. Comer, G. Kittel, and D. Dorfman. 2001. Great Basin: an ecoregion-based conservation blueprint. The Nature Conservancy, Reno, NV. 160 pp. + appendices.

NatureServe. 2009. Terrestrial Ecological Systems of the Conterminous United States. Version 2.7. Completed in cooperation with USGS Gap Analysis Program and inter-agency LANDFIRE. MMU approx. 2 hectares. NatureServe, Arlington, VA, USA. Digital map.

Neff JC, AP Ballantyne, GL Farmer, NM Mahowald, JL Conroy, CC Landry, JT Overpeck, TH Painter, CR Lawrence, RL Reynolds. 2008. Increasing aeolian dust deposition in the western United States linked to human activity. Nat Geosci doi:10.1038/ngeo133.

Noss, R. F. 1987. From plant communities to landscapes in conservation inventories: A look at The Nature Conservancy (USA). Biological Conservation 41:11-37.

Noss, R. F., C. Carroll, K. Vance-Borland, and G. Wuerthner (2002). A Multicriteria Assessment of the Irreplaceability and Vulnerability of Sites in the Greater Yellowstone Ecosystem. Conservation Biology 16(4): 895-908.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Annals of the Association of American Geographers 77:118-125.

Orloff, S. and A. Flannery. 1992. Wind turbine effects on avian activity, habitat use, and mortality in Altamont Pass and Solano County Wind Resource Areas, 1989–1991. Final Report to the California Energy Commission, Sacramento, Calif. 150. p.

Osborn R.G., Higgins K.F., Usgaard R.E., Dieter C.D. and Neiger R.D. 2000. Bird mortality associated with wind turbines at the Buffalo Ridge Wind Resource Area, Minnesota. The American Midland Naturalist 143: 41–52.

Ouren DS, C Hass, ; CP Melcher, DC Stewart, PD Ponds, NR Sexton, L Burris, T Fancher, ZH Bowen. 2007. Environmental effects of off-highway vehicles on Bureau of Land Management lands: A literature synthesis, annotated bibliographies, extensive bibliographies, and internet resources open file report 2007-1353. USDI U.S. Geological Survey

Painter TH, AP Barrett, CC Landry, JC Neff, MP Cassidy, CR Lawrence, KE McBride, G Lang Farmer. 2007. Impact of disturbed desert soils on duration of mountain snowcover. Geophys Res Lett 34: L12502,

Parmesan, Camille and Gary Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421: 37-42.

Parrish, J. D., D. P. Braun, et al. 2003. Are we conserving what we say we are? Measuring Ecological Integrity within Protected Areas. BioScience 53(9): 851-860. 2002 in text pg 21

Patthey P., S. Wirthner, N. Signorell and R. Arlettaz. 2008. Impact of outdoor winter sports on the abundance of a key indicator species of alpine ecosystems. Journal of Applied Ecology 45, 1704-1711

http://www3.interscience.wiley.com.journals.conserveonline.org:2048/journal/121421746/abstract?CRETRY=1&SRETRY=0
Pepper, CB., M.A. Nascarella, R.A. Kendall. 2003. A Review of the Effects of Aircraft Noise on Wildlife and Humans, Current Control Mechanisms and the need for Further Study. Environmental Management. 32: 418-432
Pringle, CM, MC Freeman, BJ Freeman. Regional Effects of Hydrologic Alterations on Riverine Macrobiota in the New World: Tropical-Temperate Comparisons. BioScience. September 2000, Vol. 50, No. 9, Pages 807–823
Pringle, CM. 2001. Hydrologic Connectivity and the Management of Biological Reserves: A Global Perspective. Ecological Applications. 11:981—998.
Prose, D.V. 1985. Persisting effects of armored military maneuvers on some soils of the Mojave Desert. Environ. Geol. Water Sci. 7 3 (1985), pp. 163–170
Reed SE, and AM Merenlender. 2008. Quiet, nonconsumptive recreation reduces protected area effectiveness. Conserv Lett.2008;1:146–154
Reheis, M. C. 1997. Dust deposition downwind of Owens (dry) Lake, 1991–1994: Preliminary findings. Journal of Geophysical Research, Vol. 102, No. D22, pp. 25,999-26,008
Rowe, Rebbecca J. 2007. Legacies of Land Use and Recent Climate Change: The Small Mammal Fauna in the Mountain of Utah. Am Nat Vol. 170, pp. 242–257
Rowland, M. M., L. H. Suring, M. J. Wisdom, L. Schueck, R. J. Tausch, R. F. Miller, C. Wolff Meinke, S. T. Knick, and B. C. Wales. 2003. Summary results for BLM Field Offices in Nevada from a regional assessment of habitats for species of conservation concern. 66 pp. Unpublished report on file at: USDA Forest Service, Pacific Northwest Research Station, La Grande, Oregon.
Sada, D. 2001. Springsnails of Nevada. Unpublished draft manuscript. Desert Research Institute, Reno, NV.17 pp.
Sada, D.W, Williams J.E., Silvey J.C., Halford A., Ramakka J., Summers P., and L. Lewis. 2001. A guide to managing, restoring, and conserving springs in the Western United States. Denver: Bureau of Land Management. Report nr 1737-17. 70 pp.
Saint Amand, P., L. Mathews, C. Gaines, and R. Reinking. 1986. Dust storms from Owens and Mono Lakes. TP. 6731. Naval Weapons Center, China Lake, CA.
Sanderson, E.W., Redford, K.H., Vedder, A., Ward, S.E., and Coppolillo, P.B. 2002. A conceptual model for conservation planning based on landscape species requirements. Landscape and Urban Planning 58: 41-56.
Sayre, R., P. Comer, H. Warner, and J. Cress. 2009. A new map of standardized terrestrial ecosystems of the conterminous United States: U.S. Geological Survey Professional Paper 1768, 17 p.
Schuster PF, Krabbenhoft DP, Naftz DL, Cecil LD, Olson ML, Dewild JF, Susong DD, Green JR, and Abbott ML., 2002. Atmospheric mercury deposition during the last 270 years: A glacial ice core record of natural and anthropogenic sources. Environ. Sci. Technol. 36,2303-2310.
Seager, R, M Ting, I Held, Y Kushnir, J Lu, G Vecchi, HP Huang, N Harnik, A Leetmaa, NC Lau, C Li, J Velez, N Naik. 2007. Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America. Science 316: 1181 – 1184.
Shupe, J.B. and Jack D. Brotherson. 1985. Differential Effectgs of Cattle and Sheep Grazing on High Mountain Meadows in the Strawberry Valley of Central Utah. Great Basin Naturalist Vol 45(1):141-149
Shepard, W.D. 1993. Desert springs-both rare and endangered. Aquatic Conservation: Marine and Freshwater Ecosystems 3(4):351-359.
Sitch, S., B. Smith, I. C. Prentice, A. Arneth, A. Bondeau, W. Cramer, J. O. Kaplan, S. Levis, W. Lucht, M. T. Sykes, K. Thonicke and S. Venevsky. 2003. Evaluation of ecosystem dynamics, plant geography and terrestrial carbon cycling in the LPJ dynamic global vegetation model. Global Change Biology 9:161-185.

Smith, Stanley D., Travis E. Huxman, Stephen F. Zitzer, Therese N. Charlet, David C. Housman, James S. Coleman, Lynn K. Fenstermaker, Jeffrey R. Seemann & Robert S. Nowak. 2000. Elevated CO_2 increases productivity and invasive species success in an arid ecosystem. Nature. 408:79-82.

Spaulding, S.A., and L. Elwell. 2007. Increase in nuisance blooms and geographic expansion of the freshwater diatom Didymosphenia geminata: U.S. Geological Survey Open-File Report 2007-1425, 38 p.

Steiger, J.W., and R.H. Webb. 2000. Recovery of perennial vegetation in military target sites in the eastern Mojave Desert, Arizona. U.S. Geological Survey Open-®le Report OF 00-355, (http://geology.usgs.gov/open-®le).

Stoms, D. M., P. J. Comer, P. J. Crist and D. H. Grossman. 2005. Choosing surrogates for biodiversity conservation in complex planning environments. Journal of Conservation Planning 1: 44-63.

Stromberg, Juliet, M.K. Chew, P.L. Nagler and E.P. Glenn. 2009. Changing Perceptions of Change: The Role of Scientists in Tamarix and River Management. Restoration Ecology Vol 17 No 2: pp 177-186.

Sundquist, E.T., Ackerman, K.V., Bliss, N.B., Kellndorfer, J.M., Reeves, M.C., and Rollins, M.G., 2009, Rapid assessment of U.S. forest and soil organic carbon storage and forest biomass carbon sequestration capacity: U.S. Geological Survey Open-File Report 2009–1283, 15pp. http://pubs.usgs.gov/of/2009/1283.

Taylor, Frances R., Leah A. Gillman and John W. Pedretti. 1989. Impact of Cattle on two Isolated Fish Populations in Pahranagat Valley, Nevada. Great Basin Naturalist Vol 49, No 4 pp 491-495

Theobald, D.M. 2001. Land use dynamics beyond the American urban fringe. *Geographical Review* 91(3):544-564.

Theobald, D.M. 2005. Landscape patterns of exurban growth in the USA from 1980 to 2020. Ecology and Society 10(1): 32. http://www.ecologyandsociety.org/vol10/iss1/art32/.

Theobald, D.M., D.L. Stevens, Jr., D. White, N.S. Urquhart, A.R. Olsen, and J.B. Norman. 2007. Using GIS to generate spatially-balanced random survey designs for natural resource applications. Environmental Management 40(1): 134-146.

Thomas, Chris D., Alison Cameron, Rhys E. Green, Michel Bakkenes, Linda J. Beaumont, Yvonne C. Collingham, Barend F. N. Erasmus, Marinez Ferreira de Siqueira, Alan Grainger, Lee Hannah, Lesley Hughes, Brian Huntley, Albert S. van Jaarsveld, Guy F. Midgley, Lera Miles, Miguel A. Ortega-Huerta, A. Townsend Peterson, Oliver L. Phillips and Stephen E. Williams. 2004. Extinction risk from climate change. Nature 427: 145-148.

Thompson, B.C., Matusik-Rowan P.L., and K. G. Boykin. 2002. Prioritizing conservation potential of arid-land montane natural springs and associated riparian areas. Journal of Arid Environments 50(4):527-547.

Trimble, S. 1989. The sagebrush ocean: a natural history of the Great Basin. University of Nevada Press, Reno, NV. 248 pp.

U.S. Environmental Protection Agency (USEPA) (2007) Level III Ecoregions of the Conterminous United States. map. http://www.epa.gov/wed/pages/ecoregions.htm

U.S. Geological Survey (USGS). 2006. National Hydrography Dataset Web site, http://nhd.usgs.gov/index.html.

Vannote R.L., G.W. Minshall, K.W. Cummins, J.R. Sedell, and C.E. Cushing. 1980. The River Continuum Concept. Canadian Journal of Fisheries and Aquatic Sciences. 37. Ottawa, 130-137.

Unnasch, R.S., D. P. Braun, P. J. Comer, G. E. Eckert. 2008. The Ecological Integrity Assessment Framework: A Framework for Assessing the Ecological Integrity of Biological and Ecological Resources of the National Park System. Report to the National Park Service.

USDA Natural Resources Conservation Service (NRCS) 2006. Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin. United States Department of Agriculture Handbook 296. 663 p.

USDA Natural Resources Conservation Service (NRCS). 2009. *Summary Report: 2007 National Resources Inventory*, U.S. Department of Agriculture Natural Resources Conservation Service, Washington, DC, and Center for Survey Statistics and Methodology, Iowa State University, Ames, Iowa. 123 pages. http://www.nrcs.usda.gov/technical/NRI/2007/2007_NRI_Summary.pdf

USGCRP. 2009. Global Climate Change Impacts in the United States. U.S. Global Change Research Program report. Cambridge University Press. 189pp.

Van Donk SJ, X Huang, EL Skidmore, AB Anderson, D Gebhart , V Prehoda, EM Kellogg. 2003. Wind erosion from military training lands in the Mojave Desert, California, USA. J Arid Environ. 54(4):687–703.

Vasek, F. C.; Johnson, H. B.; Eslinger, D. H. 1975. Effects of pipeline construction on creosote bush scrub vegetation of the Mojave Desert. Madrono. 23(1): 1-13

Wade, A.A., and D.M. Theobald. 2010. Residential encroachment on U.S. protected areas. Conservation Biology 24(1):151-161.

Weisenberger, M.E. P.R. Krausman, M.C. Wallace, D.W. De Young, O.E. Maughan. 1996. Effects of Simulated Jet Aircraft Noise on Heart Rate and Behavior of Desert Ungulates. The Journal of Wildlife Management, Vol. 60, No. 1 (Jan., 1996), pp. 52-61

Westerling, A. L., H. G. Hidalgo, D. R. Cayan, and T. W. Swetnam. 2006. Warming and earlier spring increase Western U.S. wildfire activity. Science 313: 940-943.

Wildlife Action Plan Team (WAPT). 2006. Nevada Wildlife Action Plan. Nevada Department of Wildlife, Reno.

Wilson, K.A., E. Meijaard, S. Drummond, H.S. Grantham, L. Boitani, G. Catullo, L. Christie, R. Dennis, I. Dutton, A. Falcucci, L. Maiorano, H. Possingham, C. Rondinini, W. Turner, O. Venter, & M. Watts. (in press). Conserving biodiversity in production landscapes. Ecological Applications.

Wisdom, M. J., L. H. Suring, M. M. Rowland, R. J. Tausch, R. F. Miller, L. Schueck, C. Wolff Meinke, S. T. Knick, and B. C. Wales. 2003. A prototype regional assessment of habitats for species of conservation concern in the Great Basin Ecoregion and State of Nevada. Version 1.1, September 2003, unpublished report on file at USDA Forest Service, Pacific Northwest Research Station, La Grande, OR 97850. http://sagemap.wr.usgs.gov/ProjectData.aspx; Sagebrush Assessment Project.

Zink, T. A., M. F. Allen, B. Heindl-Tenburen, and E. B. Allen. 1995. The effect of a disturbance corridor on an ecological reserve. *Restoration Ecology* 3:304–310

Appendices

Appendix 1. Management Questions

The penulultimate set of MQs, based on the preliminary set supplied by BLM (which can be reviewed in Memo I-1-a), followed by evaluations and discussion at AMT1. Each MQ is cross referenced with relevant CEs and CAs. Notes refer to additional concerns that require resolution, in some cases later in Phase 1.

Management Questions: Central Basin & Range			
Species			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
What is the current distribution of occupied habitat for each CE, including seasonal habitat, and movement corridors?	Each CE		
Where are current CE populations potentially affected by change agents (and potentially at risk)?	Each CE crossed with CAs	All CAs	
What is the current distribution of suitable habitat for each CE?	Each CE		
Where are change agents potentially affecting this habitat and/or movement corridors?	Each CE crossed with CAs	All CAs	
Where are CEs whose habitats are systematically threatened by CAs (other than climate change)?	Subset of CEs with restricted habitats	All CAs	During Task 3, select CE subset
What areas have been surveyed and what areas have not been surveyed (i.e., data gap locations)?	Each CE		
Given current and anticipated future locations of change agents, which habitat areas remain as opportunities for habitat enhancement/restoration?	Subset of CEs		During Task 3, select CE subset or specific habitats.
Where are potential areas to restore connectivity?	Selected subset of habitats and locations.		Determine which CEs have connectivity as a relevant concern. Select subset of habitats or locations.
Where will CEs experience climate outside their current climate envelope?	Each CE	Climate Change	Standard climate envelope analysis
Native Plant Communities			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are intact CE vegetative communities located?	All CEs that are vegetative communities		
Where are the locations that most likely include the highest-integrity examples of each major terrestrial ecological system type?	All CEs that are vegetative communities		Develop metric for Integrity that can be applied to CE communities with available data.

Where will these current communities be potentially affected by Change Agents?	All CEs that are vegetative communities crossed with CAs	All CAs	
Where will current locations of these communities experience significant and abrupt deviations from normal climate variation?	All CEs that are vegetative communities	Climate Change	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Terrestrial Sites of High Biodiversity			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are High Biodiversity sites?	Ecoregion-wide		During Task 3, develop a specific working definition of "high biodiversity". For example, is it just species richness, R? Or richness of CEs?
Where will these High Biodiversity sites be potentially affected by Change Agents?	All High Biodiversity sites (working definition required) crossed with CAs	All CAs	
Where will current locations of these High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All High Biodiversity sites (working definition required)	Climate Change, potentially other CAs	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Aquatic Sites of High Biodiversity			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
What areas have been (and have not been) surveyed for spring snails and other species of concern?	All aquatic CEs		
Where are Aquatic High Biodiversity sites?	All Aquatic High Biodiversity sites (working definition required)		During Task 3, develop a specific working definition of "high biodiversity". For example, is it just species richness, R? Or richness of CEs?
Where will these Aquatic High Biodiversity sites be potentially affected by Change Agents?	All Aquatic High Biodiversity sites (working definition required) crossed with CAs	All CAs	
Where will current locations of these Aquatic High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All Aquatic High Biodiversity sites (working definition required)	Climate Change	TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Specially Designated Areas of Ecological Value			

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Where are specially designated areas of ecological value?	Ecoregion-wide		Define subset from the list of CEs or other designated locations.
Exotic Ungulate Grazing (Livestock, Wild Horses and Burros)			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are the current populations of Wild Horses?	Wild horses		
Where are the current of populations of Burros?	Burros		
Where are the current Herd Management Areas (HMAs)?	Wild horses, Burros		
Which HMAs are exceeding AML?	Wild horses, Burros	Exotic ungulate grazing	
Which current MHA will experience significant effects of Change Agents?	HMAs, Grazing	All CAs	
Which current Allotments will experience significant effects of Change Agents?	Allotments, Grazing	All CAs	
Which Allotments and HMA will experience climate outside their current climate envelope?	HMAs, Allotments, Grazing	Climate Change, Exotic ungulate grazing	Standard climate envelope analysis
Soils			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are target soil types within the ecoregion?	Ecoregion-wide		Develop list of relevant soil types.
Where will these target soil types be potentially affected by Change Agents?	All target soil types (working definition required) crossed with CAs	All CAs	
Where will current locations of these High Biodiversity sites experience significant and abrupt deviations from normal climate variation?	All target soil types (working definition required)		TBD: Climate models to use and the definition of "significant". This could evolve into a standard climate envelope analysis.
Surface and Subsurface Water Availability			

Management Question	Relevant Conservation Elements or other analysis unit	Relevant Change Agents	Notes
Where are current water resources, both natural and man-made?	All surface water bodies		Note: coordinate with a related question in Groundwater Extraction.
Of these water resources, which are perennial, ephemeral, etc?	All surface water bodies		
Of these water resources, what is their surface water/groundwater connectivity?	All surface water bodies		
What is the natural range of variation in high and low water levels or flows (e.g., frequency, timing, duration of high and low water levels or flows)?	All surface water bodies		
Where are the aquifers and their recharge areas?	All relevant areas		
Where will these water resources be potentially affected by Change Agents?	All surface water bodies crossed with CAs	Many CAs	
Aquatic Ecological Function and Structure			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
What is the condition of target aquatic systems? OR What is the condition of target aquatic systems in terms of PFC?	All surface water bodies (may require a subset)	Hydrologic alternation, Invasive species, Development	Many may not have "PFC" defined, especially if they are not riparian. Need to look beyond "function and structure" to look at factors that may contribute to resistance and resilience in the face of disturbances and change agents. This requires a conceptual model: What are the ecological and environmental factors that contribute the most to ecological structure and function, including resistance and resilience in the face of disturbances and change agents? To be developed further during Task 3.
Where are the degraded aquatic systems (e.g., water quality)?	All surface water bodies	Hydrologic alternation, Invasive species, Development	Requires a working definition of degraded. TBD in a conceptual model.
Fire History			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	Notes
What areas have experienced significant fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	

In places that have experience fire, where does the resulting vegetative structure and composition differ from the desired state?	Among locations that have experience significant fire	Wildfire (increased and/or decreased frequency)	Requires, for each location, a definition of what constitutes "desired state". TBD in Task 3.
Fire Potential			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are current areas with high potential for fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	Devise a working definition of "potential for fire". TBD in Task 3.
Where are areas that in the future will have high potential for fire?	Ecoregion-wide	Wildfire (increased and/or decreased frequency)	Devise a working definition of "potential for fire". TBD in Task 3. Based on climate changes and potential changes in vegetation. Coordinate with other relevant MQs.
Invasive Species			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
What is the current distribution of invasive species included as CAs?	Ecoregion-wide	All invasive species CAs	
What areas are significantly ecologically affected by invasive species?	Ecoregion-wide	All invasive species CAs	Requires a working definition of "significantly ecologically affected". Various definitions are possible (e.g., dominance, alterations of ecological function, in some cases mere presence). AMT should discuss possible definitions.
Where are areas (significantly affected by invasives) that have restoration potential?	Areas identified as significantly affected by invasives.	All invasive species CAs	Requires working definition of "restoration potential. There should be specific definitions for each invasive species under consideration.
Given current patterns of occurrence and expansion, what is the potential future distribution of invasive species included as CAs?	Ecoregion-wide	All invasive species CAs	Based on climate changes and recent patterns of occurrence and expansion.
Development			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are current locations of relevant development types?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	
Where are areas of planned or potential development (outside of current urban areas)(e.g., under lease, plans of operation, governmental planning), including transmission corridors?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	Based on available planning documents.

Where are the areas of significant ecological change from these anthropogenic activities?	Ecoregion-wide	Development, Transportation and Energy Infrastructure	Based on areas thought to be the targets of development. Develop a working definition of "potential development" that incorporates proximity to existing urban areas, roads, or power lines. Develop a working definition of "significant ecological changed". TBD in Task 3.
Where do locations of current CEs overlap with areas of potential change from anthropogenic activities?	All CEs	Development, Transportation and Energy Infrastructure	Coordinate with Species and other CE-related MQs. This MQ may obviate the MQ "Where are the areas of significant ecological change from these anthropogenic activities?"
Where are ecological areas with significant recreational use?	Ecoregion-wide	Recreation (land-based, water-based)	
Groundwater Extraction and Transportation			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are aquifers and their recharge zones?	Ecoregion-wide		
Where will change agents be more powerful if groundwater is extracted?	Ecoregion-wide	All CAs	
Where are areas with groundwater resources available to sustain renewable energy projects that would not degrade aquatic ecosystems that also depend on these groundwater resources.	Ecoregion-wide	Hydrologic Alteration, Renewable Energy Development	Coordinate with Renewable Energy MQs
Where are areas under leases of water rights?	Ecoregion-wide		Assume this refers to leases of water rights, or of lands with groundwater rights.
Where are the areas showing effects from existing groundwater extraction?	Ecoregion-wide	Hydrologic Alteration	Requires a working definition of "effects".
Where are artificial water bodies including evaporation ponds, etc.?	Ecoregion-wide		Note: Coordinate with an MQ in Surface Water.
Where are the areas with groundwater basins in an overdraft condition?	Ecoregion-wide	Hydrologic Alteration	This is not a question about areas where existing groundwater extraction is having ecological effects (already addressed elsewhere) but a question of where groundwater extraction exceeds the long-term potential for recharge.
Surface Water Consumption and Diversion			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**

Where are the areas of potential future change in surface water consumption and diversion?	Ecoregion-wide	Hydrologic alteration, Climate change, Development	This should show up in any analysis of where "development" growth is most likely; and in the mapping of where water-intensive energy development is most likely.
Where are the areas with surface water resources available to sustain solar power, and other forms of development without degrading aquatic ecosystems that also depend on these groundwater resources?	Ecoregion-wide	Renewable energy development	Coordinate with Renewable Energy MQs. This is an extension of the mapping of where surface waters exist that depend on groundwater levels or discharges for their hydrology, combined with the mapping of development potential.
Where are the areas showing ecological effects from existing surface water exploitation?	Relevant CEs	Hydrologic alteration, Development	Generate this information by coupling map information on density of surface water use (diversions as well as consumption) from state and USGS reports, with information on degree of degradation of aquatic ecological integrity.
Where are artificial water bodies including evaporation ponds, etc.?	Ecoregion-wide		Coordinate with an MQ in Surface Water.
Where are the areas with existing surface water extraction that has caused natural aquatic communities to become entirely dry, either seasonally or perennially?	Relevant CEs	Hydrologic alteration, Development	Generate this information by coupling map information on existence of formerly perennial streams with where they don't exists anymore, and overlay information on intensity of upstream and adjacent surface water extraction.
Climate Change: Terrestrial Resource Issues			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where will changes in climate be greatest relative to normal climate variability?	Ecoregion-wide	Climate Change	Climate change will affect every location, but affect different locations in different ways. So the issue is not where any effects will occur, but where these effects will potentially cause significant ecological change affecting priority conservation elements. Exact climate models are TBD.
Given anticipated climate shifts and the direction shifts in distributions, where are areas of potential habitat fragmentation?	Ecoregion-wide	Climate Change	Fragmentation may be difficult to assess. Consider species-specific responses/perceptions of fragmentation.
Which native plant communities will experience climate completely outside their normal range?	CEs that are plant communities.	Climate Change	Climate envelope studies are complicated by the likelihood that assemblages will not move intact, but shift and reform based on the movements of individual species. This MQ needs further refinement during Task 3 and the analysis. Coordinate with MQ in "Native Plant Communities".
Where will wildlife habitat experience climate completely outside its normal range?	Select relevant wildlife species	Climate Change	Requires a working definition of "wildlife habitat". Coordinate with the "plant communities and climate change MQ".
Where are wildlife species ranges (on the element list) that will experience significant and abrupt deviations from normal climate variation?	Select relevant wildlife species	Climate Change	Consider further reframe as standard climate envelope analysis.

Based on recent distributions and expansion patterns of insect pests and disease, what are expected distributions in the future?	Select relevant pest species	Climate Change, Invasive species	This is a research questions that possibly requires speculation beyond the scope of the REA. This MQ remains provisional, and be dropped and listed as a gap in research.
Climate Change: Aquatic Resource Issues			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where aquatic resources that will experience significant and abrupt deviations from normal climate variation?	Ecoregion-wide	Climate Change, Hydrologic alteration	Climate change will affect every location, but affect different locations in different ways. So the issue is not where any effects will occur, but where these effects will potentially cause significant ecological change affecting priority conservation elements.
Where are aquatic resources that will experience significant and abrupt deviations from normal flow regime or mean water levels?	Ecoregion-wide	Climate Change, Hydrologic alteration	There will potentially include effects on water levels in wetlands and groundwater-driven systems, and changes in riparian inundation patterns. Plus the changes won't be in simple magnitude but may also be in the timing, duration, and frequency of different hydrologic conditions.
Where will aquatic resources experience significant and abrupt deviations from normal temperature regime?	Ecoregion-wide	Climate Change, Hydrologic alteration	Both "flow" and "hydrologic change will occur. Includes not just "temperature change" but change in the temperature regime.
Where are aquatic resources that will experience additional effects on physical habitat such as channel morphology due to significant and abrupt deviations in climate and hydrologic regimes?	Ecoregion-wide	Climate Change, Hydrologic alteration	
Military Constrained Areas			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are military constrained areas?	Ecoregion-wide	Military use areas, conflict of use areas, areas of moratoria, potential military expansion, DOE contracted areas, installation boundaries	
Where might these areas change in the future?	Ecoregion-wide	Military use areas, conflict of use areas, areas of moratoria, potential military expansion, DOE contracted areas, installation boundaries	Coordinate with various other MQs on climate change and water resources. Consult INRMP of the relevant installations to determine available data and potential presence of CEs and CAs.
Where are areas of possible expansion of military use?	Ecoregion-wide	Potential military expansion	Based on BRAC or other planning documents.

Bald Eagles, Golden Eagles			
Initial management questions	**Issues: Terms, Feasibility & Relevance to REA**	**Recommendation: Accept, Reframe, Delete**	
Where are active Bald Eagle nests?	Bald Eagle CE		
Where are active Golden Eagle nests?	Golden Eagle CE		
Atmospheric Deposition			
Management Question	**Relevant Conservation Elements or other analysis unit**	**Relevant Change Agents**	**Notes**
Where are areas affected by atmospheric deposition of pollutants (nutrient deposition, acid deposition, mercury deposition)?	Ecoregion-wide	Air and Water Quality: Fugitive dust, air pollution, atmospheric deposition	Atmospheric deposition affects ecosystems via both nutrient enrichment and via acid deposition; and affects some individual species through these effects and through mercury deposition. This is a known problem in the higher elevations of the western US.

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
	55.8%	***Basin Dryland Ecosystems***				
Inter-Mountain Basins Mixed Salt Desert Scrub	20.0%	Cool Semi-Desert	In the interior western U.S., salt desert shrublands are found in some of the driest of basins, slopes and plains. The soils usually have a high percentage of salts or calcium, often because of the rocks from which the soil is derived, or because of the high rate of evaporation of water from the surface of the soil. These salt desert shrublands experience extreme climatic conditions, with warm to hot summers, freezing winters, and low amounts of rain or snowfall. The shrubs are adapted to these dry, "saline" conditions, often having spines and small leaves, and may go dormant during extended dry periods. The most common shrubs are called "saltbush" species and include shadscale, fourwing saltbush, cattle-spinach, spinescale, spiny hopsage, or winterfat. They usually are low-growing and scattered, but sometimes can be dense. Grasses and herbs are also found, but because of the dry conditions are rarely abundant.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Inter-Mountain Basins Big Sagebrush Shrubland	19.5%	Cool Semi-Desert	Big sagebrush shrublands are one of the most widespread ecological systems in the western U.S., found in broad basins between mountain ranges, on plains and on foothills between 4900 and 7550 feet elevation. The soils are deep, well-drained and not saline. The most important sages are Wyoming big sagebrush or basin big sagebrush; other common shrubs include antelope bitterbrush, rabbitbrush, or mountain snowberry. Shrubs are the dominant vegetation, with grasses making up less than 25% of the cover, distinguishing this from Inter-Mountain Basins Big Sagebrush Steppe, which has higher grass cover. In recent years this systems has been invaded by non-native annual grasses or weeds, in particular cheatgrass, which changes fire regimes.	Upland, Cryptobiotic Crust, Wildfire	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Great Basin Xeric Mixed Sagebrush Shrubland	9.6%	Cool Semi-Desert	Low growing sagebrush shrublands are found throughout the Great Basin, on dry flats and plains, alluvial fans, rolling hills, rocky hillslopes, saddles and ridges. Usually they are found below the zone of pinyon-juniper woodlands. These habitats are dry (xeric), often exposed to desiccating winds, and the soils are shallow, rocky, and not-salty. Black sagebrush (mid and low elevations), Lahontan sagebrush, or alkali sagebrush (higher elevation) are the most common sages, but Wyoming big sagebrush is also common. Rabbitbrush, shadscale, jointfir, goldenbush, spiny hop-sage, Shockley's desert-thorn, bud sagebrush, black greasewood, and horsebrush are some of the other shrubs. Grasses and herbs are also found but are not very abundant because of the dry conditions.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover native species richness, % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements

				Ecological Integrity Factors		
Conservation Element Name	**% of Ecoregion**	**National Vegetation Classification: Formation Level**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Potential Indicators**
Inter-Mountain Basins Semi-Desert Shrub-Steppe	3.1%	Cool Semi-Desert	These are dry, open grasslands with a mix of low to medium-tall shrubs, found throughout the Intermountain West. They occur on flats and gentle lower slopes, on well-drained, usually deep soils. This semi-arid shrub-steppe is typically dominated by grasses, with an open to moderately dense cover of shrubs, usually a mix of species but sometimes a single species. Sagebrush can be present but not dominant, with rabbitbrush, horsebrush, winterfat or Mormon-tea as the most common shrubs. Characteristic grasses include Indian ricegrass, blue grama, saltgrass, curly bluegrass, muttongrass, alkali sacaton, needle-and-thread, James' galleta, and saline wildrye. Annual grasses, especially the exotics Japanese brome and cheatgrass, may be present to abundant in poor condition stands.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Mojave Mid-Elevation Mixed Desert Scrub	2.0%	Warm Semi-Desert	This desert scrub occurs above lower-elevation transition from pinyon-juniper woodlands and chaparral of the southern Great Basin into the adjacent Mojave Desert. These evergreen shrublands often have an open canopied shrub layer of blackbrush, California wild buckwheat, Nevada joint-fir, spiny hop-sage, greenfire or bladder-sage. Scattered cacti and succculents such as beargrass, buckhorn cholla, Mojave yucca or the Joshua tree (tree yucca) may be present. Desert grasses, including Indian ricegrass, desert needlegrass, James' galleta, or big galleta may form an grass layer. Scattered juniper trees or desert scrub species may also be present.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Inter-Mountain Basins Semi-Desert Grassland	1.0%	Cool Semi-Desert	These are dry grasslands found on a variety of landforms, including swales, playas, mesas, alluvial flats, and plains. The soils are often sandy or loamy. This systems is almost always dominated by drought-resistant perennial bunchgrasses (growing in clumps), especially Indian ricegrass, threeawn, blue grama, needle-and-thread, muhly, or James' galleta. Scattered shrubs and dwarf-shrubs often are present, especially basin big sagebrush, Wyoming big sagebrush, saltbush, blackbrush, joint-fir, broom snakeweed, and winterfat. These grasslands typically intergrade into salt-desert shrubs or sagebrush, and support grasslands due to unusual soils (sand, gravel or alluvium) and low rainfall.	Upland, Fire Regime	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover, landscape-level fire return interval % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
Inter-Mountain Basins Big Sagebrush Steppe	0.3%	Cool Semi-Desert	This sagebrush steppe is a mixed grassland with scattered shrubs, containing a 10-25% cover of basin big sagebrush, antelope bitterbrush or other sage-like shrubs. Native bunchgrasses that form dense clumps at their base, along with other native grasses, tend to cover well over 25% of the ground, distinguishing this from Inter-Mountain Basins Big Sagebrush Shrubland which has more shrubs and less grass. This is a very widespread type occurring on rolling and flat plains, with a variety of soil conditions. This type occurs throughout the western U.S. and is dominant in the Columbia Plateau and the northwestern Great Plains of Wyoming and Montana. Pronghorn antelope, sage grouse, pygmy rabbit, sage sparrow, and many plant and animal species utilize sagebrush steppe as their primary habitat. With exotic ungulate overgrazing and/or suppression of natural wildfires, some sagebrush steppe can be converted to sagebrush shrublands.	Upland, Fire Regime	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover, landscape-level fire return interval % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Inter-Mountain Basins Active and Stabilized Dune	0.2%	Cool Semi-Desert	This ecological system is defined by the presence of migrating and/or stabilized dunes. Stabilized dunes may become actively migrating dunes with disturbance or increased aridity. In the ecoregion, there are many small active and partially vegetated dunes along some of the larger washes and playas (where sand, blown from washes, contributes to the formation of the dunes). There are also some larger dunes associated with this system, such as the Coral Pink Dunes found in southwestern Utah. The soils are usually windblown sand, but small dunes composed of silt and clay may be found downwind from playas. Plants occupying these environments are often adapted to shifting, coarse-textured substrates (usually quartz sand) and form patchy or open grasslands, shrublands or steppe (grass and shrub mix), and occasionally woodlands. The mix of species varies and may be composed of sagebrush, saltbush, rabbitbrush, blackbrush, Indian ricegrass, needle-and-thread, yellow wildrye, or sandhills muhly.	Upland, Wind and Erosion	Landscape Connectivity Natural Disturbance Regime (sand dynamics) Native Vegetation Composition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover proportions of open/migrating, native species anchored and native species stabilized stages % cover native or human sensitive species, % cover invasive or native increaser species, presence of native sand-adapted species
Colorado Plateau Mixed Low Sagebrush Shrubland	0.1%	Cool Semi-Desert	This ecological system occurs in the canyons, gravelly draws, hilltops, and dry flats of the Colorado Plateau, Tavaputs Plateau and Uinta Basin (generally at elevations below 5900 feet). Soils are often rocky, shallow, and alkaline. In the southern Great Plains, this dry sagebrush system is found on limestone hills. These are low sagebrush shrublands, where the dry conditions limit which species are found and their abundance. Typically the cover of shrubs is low; black sagebrush or Bigelow's sagebrush, and sometimes Wyoming big sagebrush, are the most common shrubs. Grasses adapted to semi-arid conditions are also found, such as Indian ricegrass, purple threeawn, blue grama, needle-and-thread, James' galleta, or muttongrass.	Upland, Cryptobiotic Crust	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Great Basin Semi-Desert Chaparral	0.0%	Cool Semi-Desert	This evergreen shrubland (chaparral) occurs above lower-elevation cold desert scrub and below pinyon-juniper woodlands of the western and	Upland, Fire Regime	Landscape Connectivity	degree of non-natural fragmentation of larger landscape, % of larger landscape in

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
			central Great Basin extending west into central California. These shrublands have an open canopy with spaces between shrubs either bare or supporting patchy grasses and herbs. Common shrubs include Greenleaf manzanita, Mexican manzanita, mountain-mahogany, littleleaf mountain-mahogany, California wild buckwheat, and turbinella live oak. Curl-leaf mountain-mahogany is generally absent. Fires are an important ecological process in chaparral. Most chaparral plants are fire-adapted, resprouting vigorously after burning or producing fire-resistant seeds.		 Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % recovery of fire-adapted shrubs post-fire degree of soil compaction or disturbance from non-natural sources
	11.0%	***Basin Wet Ecosystems***				
Inter-Mountain Basins Playa	5.7%	Cool Semi-Desert Wet Flat	Barren, usually alkaline desert playas (dry lakebeds), are found in closed basins in the Intermountain West. These basins are intermittently (once every few years) or seasonally (every year) flooded. Water is prevented from percolating through the soil by an impermeable subsurface layer and is left to evaporate. Salt crusts and high salt in the soils greatly affect species composition. While the appearance is barren, some species such as iodinebush, black greasewood, spiny hopsage, Lemmon's alkali grass, Great Basin wildrye, saltgrass, or saltbush occur around the margins of the playa. This system grades into salt-desert scrub and sagebrush habitats. Downwind of playas, active and stabilized sand dunes often form.	Intermittent Flooding, Evaporation, Wind	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) % cover native or human sensitive species, % cover invasive or native increaser species bare soil due to natural depositional processes, or game trails
Inter-Mountain Basins Greasewood Flat	5.1%	Cool Semi-Desert Wet Flat	This ecological system occurs in intermountain basins throughout much of the western United States. These "flats" are usually found adjacent to drainage areas, such as on stream terraces and flats, or ringing the margins of playas and desert lakes. Greasewood forms open tall shrublands; sometimes alone, or sometimes with other shrubs. These are usually near salt-desert scrub communities, big sagebrush shrublands or steppe (shrublands with high cover of grasses). While many of these areas can be very sparse, seasonal moisture can support grasses, sometimes with fairly high cover, ranging from 6-foot tall basin wildrye to very low saltgrass. In many places, black greasewood shrublands have been invaded by cheatgrass, which often outcompetes the native grasses and herbs, and increases the risk of wildfire. When cheatgrass dies in late summer, it easily catches fire and can carry flames to the nearby shrubs.	Intermittent Flooding, Evaporation, Wind	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) % cover native or human sensitive species, % cover invasive or native increaser species bare soil due to natural depositional processes, or game trails

Appendix 2 Coarse Filter Conservation Elements

				Ecological Integrity Factors		
Conservation Element Name	**% of Ecoregion**	**National Vegetation Classification: Formation Level**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Potential Indicators**
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland/Stream	1.1%	Temperate Flooded & Swamp Forest	These are riparian woodlands and shrublands found in the foothills and mountains of the Great Basin and eastern Sierra Nevada. They are usually narrow wet habitats along the streams, forming a patchy mosaic of open woodlands or forests, willows, rushes, sedges, and moist herbs and grasses. Common trees include narrowleaf cottonwood, black cottonwood, Fremont cottonwood, Goodding's willow and conifers such as white fir, and Douglas-fir. Shrubs such as silver sagebrush, red-osier dogwood, and willows (arroyo, Booth, coyote, Lemmon's or yellow) are common. The habitats are often altered by livestock overuse, causing them to be open, with fewer shrubs and trees with introduced grazing-tolerant grasses such as Kentucky bluegrass, creeping bentgrass, timothy common.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails
Inter-Mountain Basins Desert Wash	not estimated	Cool Semi-Desert	These intermittently flooded washes or arroyos often dissect alluvial fans, mesas, plains and basin floors throughout the cool deserts of western North America. Although often dry, the stream processes define this type, which are often associated with rapid sheet and gully flow. Desert wash plants may be sparse and patchy to moderately dense, typically occurring along the banks, but occasionally within the channel. Plants are quite variable but are mostly shrubs and small trees such as low sagebrushes and black greasewood,. Washes are important habitat for many animals in the desert.	Intermittent Flooding, Evaporation	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s) % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & bare soil due to natural depositional processes
North American Arid West Emergent Marsh/Pond	0.2%	Temperate & Boreal Freshwater Marsh	These are natural marshes that occur in depressions with ponds, and along slow-flowing streams and rivers (sloughs). They are frequently or continually flooded with water depths up to 6 feet deep, but have rooted, mostly grasslike plants. They usually have peat or muck in the bottom and occur in dry environments, typically surrounded by savanna, shrub-steppe, steppe, or desert vegetation. Common emergent and floating vegetation includes bulrushes, cattails, rushes, pondweeds, knotweeds, pond-lilies, and canarygrass	Groundwater , Surface water flow	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) diversity of native species, % cover native or human sensitive species, % cover invasive or native increaser species, amount of organic matter accumulation bare soil due to natural depositional processes, or game trails

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Ecological Integrity Factors: Key Ecological Attributes	Ecological Integrity Factors: Potential Indicators
Great Basin Springs and Seeps	0.0%	Cool Semi-Desert	These are found either as artesian outflow from rock or alluvium at the base of slopes. They may be isolated or adjacent to slow-flowing streams. They are frequently or continually flooded, but with very shallow water depth. Some may include marshy vegetation around their margins. They usually have a mineral bottom and occur in dry environments, typically surrounded by desert scrub or shrub-steppe. If present, emergent and floating vegetation includes bulrushes, rushes, or pondweeds.	Groundwater	Watershed Connectivity Hydrology Native Aquatic Composition Surrounding Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) diversity of native species, % native or human sensitive species, % invasive or native increaser species bare soil due to natural depositional processes, limited compaction
	19.5%	***Montane Dryland Ecosystems***				
Great Basin Pinyon-Juniper Woodland	13.8%	Cool Temperate Forest	These woodlands occur on dry mountain ranges of the Great Basin region and eastern foothills of the Sierra Nevada. They are found on warm, dry sites on mountain slopes, mesas, plateaus and ridges, above the valleys where sagebrush is dominant. Severe weather events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to a relatively narrow altitudinal zones. Singleleaf pinyon and Utah juniper, alone or mixed together, are the main trees. Curl-leaf mountain-mahogany is also common with the pinyon-juniper. Shrubs and grasses may be abundant to absent all together. Typical species include manzanita, sagebrush, blackbrush, turbinella live oak, needle-and-thread grass, Idaho fescue, bluebunch wheatgrass, great basin lyme grass, and muttongrass.	Upland, Fire Regime	Landscape Connectivity Natural Disturbance Regime (fire) Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover evidence of recent fire in appropriate sites (deep soils) tree density, % cover native or human sensitive species, % cover invasive or native increaser species, % cover non-native annual grasses, % cover of native perennial grasses, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements

				Ecological Integrity Factors		
Conservation Element Name	**% of Ecoregion**	**National Vegetation Classification: Formation Level**	**Description**	**Functional Require-ments**	**Key Ecological Attributes**	**Potential Indicators**
Inter-Mountain Basins Montane Sagebrush Steppe	3.9%	Cool Semi-Desert	These are very widespread mountain sagebrush habitats always dominated by mountain big sagebrush, but with a lush grass and herb component. The overall appearance may be of a grassland with scattered shrubs. These grassy shrublands (shrub-steppe) are found on mountain foothills and slopes, in areas ranging from deep soils to shallow stony flats and ridgetops. In general, this system shows an affinity for mild topography, fine soils, some source of moisture in the soil or more mesic sites, zones of higher precipitation and areas of snow accumulation. Other common shrubs include mountain silver sagebrush, antelope bitterbrush, snowberry, serviceberry, rubber rabbitbrush, wild crabapple, wax currant, and green rabbitbrush. Varied native bunchgrasses are almost always codominant. Higher in the mountains, wildflowers become abundant and often occur in a matrix with montane and subalpine woodlands. In many areas, wildfires can maintain an open herbaceous-rich steppe condition.	Upland, Fire Regime	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, % cover native bunchgrasses, % recovery of fire sensitive shrubs post-fire, degree of intactness of biological soil crust degree of soil compaction or disturbance from non-natural sources
Inter-Mountain Basins Cliff and Canyon	0.7%	Cool Semi-Desert Cliff, Scree & Other Rock Vegetation	This ecological system is found from foothill to subalpine elevations and includes the barren and sparsely vegetated landscapes (generally less than 10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included within this system is the vegetation of unstable scree and talus slopes that typically occurs below cliff faces. Widely scattered trees and shrubs may include white fir, two-needle pinyon, limber pine, singleleaf pinyon, junipers, basin big sagebrush, antelope bitterbrush, curl-leaf mountain-mahogany, joint-firs, hillside oceanspray, and other species often common in adjacent plant communities.	Upland, Wind and Erosion	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, proportions of different patch types (e.g. woodland, shrubland, bare rock) degree of soil compaction or disturbance from non-natural sources
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	0.6%	Cool Temperate Forest	Curl-leaf mountain-mahogany shrublands or woodlands are usually found on rocky outcrops and warm south-facing hillslopes from canyons and foothills to mountain ridgetops. These extensive woodlands and shrublands are common across the Great Basin to the Sierra Nevada and extend east into south-central Montana and western Colorado. Most areas have exposed rock and bunchgrasses, sometimes with scattered mountain sagebrush, antelope bitterbrush, snowberry shrubs, or juniper and pinyon trees. Curl-leaf mountain-mahogany is a slow-growing, drought-tolerant shrub that generally does not resprout after burning and needs the protection from fire that rocky sites provide. It will recolonize a burned area if a seed source is available. Mountain-mahogany is important food for deer and elk	Upland, Fire Regime	Landscape Connectivity Natural Disturbance Regime (fire) Native Vegetation Composition & Expected Vegetation Structure	degree of fragmentation of larger landscape, % of larger landscape in natural land cover degree of departure from historic fire regime % cover native or human sensitive species, % cover invasive or native increaser species, % cover of native understory species

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
Rocky Mountain Aspen Forest and Woodland	0.2%	Cool Temperate Forest	With their trembling green or gold leaves and white bark, quaking aspen forests make for some of the most beautiful western forests. They are found in a wide range of elevations (5000 to 10,000 feet) across the Rocky Mountains and Great Basin wherever adequate rain or snowfall maintains the soil moisture that deciduous trees need. The shrubs, herbs and grasses found in aspen forests are very diverse. Aspen is a clonal species, with groups of trees growing from the same roots spread through a large area. After a fire (or other event such as avalanche, insect outbreak or clearcutting by man or beaver) kills a conifer or aspen forest, the aspen clones can rapidly re-sprout to become a new aspen forest. Some aspen clones are thought to be many centuries old, even though the trees themselves only live about 150 years.	Upland, Fire and Wind	Landscape Connectivity Natural Disturbance Regime (fire, wind) Native Vegetation Composition & Expected Vegetation Structure	degree of fragmentation of larger landscape, % of larger landscape in natural land cover degree of departure from historic fire regime presence of multiple size aspen stems and young regeneration, % cover native or human sensitive species, % cover invasive or native increaser species, % cover of native understory species, degree of aspen mortality or disease
Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	0.2%	Cool Temperate Forest	In the high mountains of the Great Basin and eastern California, limber pine and bristlecone pine woodlands are found on high-elevation ridges and rocky slopes above the subalpine forests. Sites are harsh for woody plants, with drying winds, rocky soils and a short growing season. These woodlands often are on southwestern-facing steep slopes, or on ridge tops. The trees are widely-spaced, and gnarled when they are mature. Intermountain bristlecone pines can reach ages well over 1,500 years. Shrubs, grasses and herbs are typically not abundant. Often the herbs are 'cushion plants', a group of plants with low, matted appearance which protects them from the dry, cold winds. The seeds of limber pine are collected by Clark's nutcracker, and are cached by these birds for future food. Sometimes the seed caches are not returned to by the nutcrackers, and clumbs of seeds will sprout, with many pine seedlings then growing all together.	Upland, Fire and Wind	Landscape Connectivity Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	degree of non-natural fragmentation of larger landscape, % of larger landscape in natural land cover % cover native or human sensitive species, % cover invasive or native increaser species, presence of multiple age & size classes of pines, blister rust degree of soil compaction or disturbance from non-natural sources

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	0.0%	Cool Temperate Forest	These are woodlands and forests found across the Intermountain West, but especially in the mountains of the Colorado Plateau and Great Basin. They occur on moist soils on slopes in the mountains, but are also found on clay-rich soils in inter-montane valleys. These forests are a mix of deciduous and coniferous trees, with quaking aspen always abundant, and one or more conifer species, especially ponderosa pine, Douglas-fir, subalpine fir, Engelmann spruce, or lodgepole pine. As the forest ages, quaking aspen slowly die out until the conifer species become dominant. Many different shrubs, grasses or herbs are found in these forests, which can be quite diverse in species. Many of these mixed forests are believed to have replaced pure aspen forests due to fire suppression and heavy exotic ungulate grazing. Aspen is thin-barked and readily killed by fire, but it is adapted to fire by re-sprouting from rootstock when the trees are killed. Without fire, these mixed forests will slowly convert to a conifer-dominated forest	Upland, Fire Regime	Landscape Connectivity Natural Disturbance Regime (fire) Native Vegetation Composition & Expected Vegetation Structure	degree of fragmentation of larger landscape, % of larger landscape in natural land cover degree of departure from historic fire regime diversity of age class structure, proportions of conifer & aspen patches, presence of multiple size aspen stems & young regeneration, % cover of conifers (mature & regeneration), % cover native or human sensitive species, % cover invasive or native increaser species, % cover of native understory species, degree of aspen mortality or disease
	1.3%	***Montane Wet Ecosystems***				
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland/Stream	0.1%	Temperate Flooded & Swamp Forest	Found at lower elevations in the Rocky Mountains, these often lush streamside woodlands and shrublands occur on streambanks, adjacent floodplains, and can occur on in-stream islands, and sand or cobble bars. They can form large, wide woodlands along larger rivers or may be limited to narrow bands on small, rocky canyon tributaries and well-drained benches. They are also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches. Hardwood trees and tall shrubs (cottonwood, maple, alder, western birch, creek dogwood and willows), conifers (Douglas-fir, spruce or ponderosa pine) dominate most sites, with a diverse understory of low shrubs (rose, snowberry), wildflowers and grasses.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails

Appendix 2 Coarse Filter Conservation Elements

Conservation Element Name	% of Ecoregion	National Vegetation Classification: Formation Level	Description	Ecological Integrity Factors: Functional Require-ments	Key Ecological Attributes	Potential Indicators
Rocky Mountain Subalpine-Montane Riparian Woodland/Stream	0.0%	Temperate Flooded & Swamp Forest	These are the woodlands and forests that are found along rivers and streams from mid elevations to the upper limit of treeline in the Rocky Mountains. This includes the narrow streamside forests and woodlands in steep, V-shaped valleys and canyons, extending to broader floodplains in wide valley bottoms. Trees include subalpine fir, Douglas-fir, Engelmann spruce, aspen, cottonwood, and mountain alder, and have understories with diverse shrubs and wildflowers.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native trees or shrubs, proportions & types of seral stages or patch types bare soil due to natural depositional processes, or game trails
Rocky Mountain Subalpine-Montane Riparian Shrubland/Stream	0.0%	Temperate Flooded & Swamp Forest	This riparian shrubland is found along rivers and streams from mid elevations to the upper limit of the treeline in the Rocky Mountains, & ranges of the Great Basin. It includes deciduous shrublands, dominated by different willow species (which vary by area and elevation), mountain alder, western birch, with diverse low shrubs and forbs in the understory. This ecological system includes streamside shrublands ranging from narrow stream borders in steep, V-shaped valleys and canyons, to broader floodplains in wide valley bottoms. It also includes headwater basins in the alpine to subalpine transition where willow shrublands can form dense thickets on the slopes, with small rivulets running throughout them as winter snow melts.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover, number & type of patches within reaches presence / absence of catchments, dams, diversions, extractive processes; naturalness of water source(s), degree of streambank stability % native or human sensitive species, % cover invasive species, evidence of woody species regeneration, % cover of mature native shrubs bare soil due to natural depositional processes, or game trails
Rocky Mountain Alpine-Montane Wet Meadow/Alpine Lake	0.0%	Temperate & Boreal Freshwater Marsh	These are high-elevation communities found throughout the Rocky Mountains and Intermountain West andare dominated by herbaceous species found on wet sites with very low-gradient surface and subsurface flows. They range in elevation from montane to alpine (3200-11,800 feet). They occur as large meadows in montane or subalpine valleys, as narrow strips bordering ponds, lakes and streams, and along toe-slope seeps. In alpine regions, sites typically are small depressions located below late-melting snow patches. Wet meadows are dominated by grasses, sedges or wildflowers, such as western bluejoint, white marsh-marigold, large mountain bittercress, small-head sedge, small-wing sedge, black alpine sedge, Holm's Rocky Mountain sedge, Northwest Territory sedge, native sedge, tufted hairgrass, few-flower spikerush, Drummond's rush, ice grass, yellowcress, arrowleaf ragwort, Parry's clover, and American globeflower.	Seasonal Flooding	Watershed Connectivity Hydrology Native Vegetation Composition & Expected Vegetation Structure Soil Surface Condition	% watershed in natural land cover degree of natural patterns of flooding or drying; presence / absence of dikes, diversions, ditches, flow additions, or fill that restrict or redirect flow; naturalness of water source(s) diversity of native species, % cover native or human sensitive species, % cover invasive or native increaser species, amount of organic matter accumulation bare soil due to natural depositional processes, or game trails

Appendix 3: Change Agent Assessment

See text for explanation of fields. The “Include” field identifies those CAs vetted and recommended for inclusion by the AMT.

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Class I Wildfire								
Increased fire frequency	Billings 1994 as cited in Wisdom et al.. 2003	Increase fire frequency, eliminated native shrubs, complete replacement to annual grass ecosystem (Billings 1994 as cited in Wisdom et al 2003)	Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland		Disturbances such as exotic ungulate grazing or development promote invasion of *Bromus* and other exotics	x	x	
Decreased fire frequency	Miller and Wigand 1994, Miller and Tausch 2001 as cited in Wisdom et al. 2003	invasion of Pinyon and Juniper ((Miller and Wigand 1994, Miller and Tausch 2001 as cited in Wisdom et al.. 2003)	Inter-Mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Montane Sagebrush Steppe	These systems are most susceptible as pinyon-juniper establishment is most likely on wet, cool sites with moderately deep soil (Wisdom et al.. 2003)		x		
Class II Development								
Urban development	Major and Parsons 2010	Shift in bird community composition, with an increase in larger bodied birds and a reduction in insectivorous birds (Major and Parsons 2010)	Bird communities			x		
Urbanization subclass	Theobald 2001; Theobald 2005; EPA 2009	Habitat destruction and fragmentation and modification of ecological processes (Hansen et al. 2005), introduction of non-native invasive species (WAPT 2006)				x	x	
Urban commercial/industrial	Theobald 2001; Theobald 2005; EPA 2009		Riparian ecosystems	Results in habitat loss and fragmentation of riparian ecosystems and warm desert scrub (NWAP)		x	x	
Urban residential (>1 per 2 ac)	Theobald 2001; Theobald 2005; EPA 2009						x	
Exurban residential (1 per 2 - 40 ac)	Theobald 2001; Theobald 2005; EPA 2009							
Recreation								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Off-road Vehicle Use	Adams & McCool 2009	The ecological consequences of ORVs range from soil compaction and erosion to noise, air, and water pollution. In many ways approximating the impacts of roads . . . ORVs directly and indirectly damage vegetation and wildlife, fragment habitat, displace sensitive species, introduce and distribute invasive species, and provide extensive access to legal hunting and illegal poaching of wildlife (Adams and McCool 2009). OHV can also effect future Wilderness Designation (Adams and McCool 2009).	Intermountain Basins Greasewood Flat Intermountain Basins Mixed Salt Desert Scrub Intermountain Basins Wash Intermountain Basins Semi-Desert Scrub Steppe Rocky Mountain Bigtooth Maple Ravine Woodland Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland Intermountain Basin Subalpine Limber-Bristlecone Pine Woodland Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland Rocky Mountain Ponderosa Pine Woodland Warm desert scrub, Aspen woodlands, riparian areas, Sand dunes (WAPT 2006))	see ecological effects		x	x	
Other Land-based	WAPT 2006, Adams and McCool 2009	Ski areas, snow parks, and developed day-use areas and campgrounds also facilitate increased disturbance to wildlife and alter the habitat through the removal of vegetation and soil compaction. (WAPT 2006), Motorized Recreation (OHV, snowmobile) wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction (WAPT 2006) Snowmobiles may have impacts associated with noise, exhaust, snow compaction, wildlife stress or displacement, and damage to exposed vegetation (Adams and McCool 2009)	Montane Meadows, Subalpine Forests, Alpine, Sand dunes, Desert Scrub, Desert Salt Flats,	wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction (WAPT 2006).	Urban populations	x	x	
Water-based	WAPT 2006	Motorized recreation (watercraft) (WAPT 2006))	Lakes and Reservoirs, fish, other aquatic elements	wildlife displacement, altered movements, decreased reproductive success, erosion, and direct habitat alteration and destruction (WAPT 2006)	Urban populations	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Dispersed recreation	Reed & Merenlender 2009	Hiking, biking, and horseback riding, especially when combined with the presence of domestic dogs caused shift in the composition of the carnivore community (Reed & Merenlender 2008).	Carnivore Communities (bobcat, coyote, fox)	Lower species richness & lower abundance		x	x	
Agriculture								
Agricultural contaminants	Nachlinger et al. 2001	non-point source pollution, direct toxicity (via herbicides and pesticides)				x	x	
Exotic Ungulate Grazing (e.g. cows and sheep)	Nachlinger et al 2001, WAPT 2006, Shupe and Brotherson 1985	trampling and removal of vegetation, erosion of stream banks, widening of streams, increases in water temperatures, allows for terrestrial native and non-native increasers, and aquatic invasives, changes in fish species composition (Chambers and Miller 2004, Medina and Marin 1988). Reduction in vigor of understory shrubs and herbs in pine forests (WAPT 2006)	Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, Great Basin Pinyon-Juniper Woodland, Inter-Mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland, Great Basin Semi-Desert Chaparral, Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland Inter-Mountain Basins Mixed Salt Desert Scrub, Great Basin Xeric Mixed Sagebrush Shrubland, Colorado Plateau Mixed Low Sagebrush Shrubland, Inter-Mountain Basins Semi-Desert Shrub-Steppe, Mojave Mid-Elevation Mixed Desert Scrub Rocky Mountain Subalpine-Montane Riparian Woodland/Shrubland and stream, Rocky Mountain Alpine-Montane Wet Meadow, Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland and stream Streams and Seeps, and other water bodies Great Basin Springs and Seeps, North American Arid West Emergent Marsh/Pond Federally listed Fish species	Federally listed fish population decline due to increased level of NH_3 and NO_2 (Taylor et al. 1989.) Damage to lichen and moss in Cryptogamic soil crusts (Johansen and St. Clair 1986). Reduction in native vascular plant cover and increase in native and non-native vascular plant species cover in montane meadows.	Fire regimes (fuel loading), invasive species terrestrial and aquatic. Exotic ungulate grazing (combined livestock and feral horse grazing) can increase negative effects (Beever and Brussard 2000). Reduction in exotic ungulate grazing intensity may mitigate the biological response to Climate Change (Rowe 2007)	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Exotic Ungulate Grazing- (i.e. Feral Horses and Burros)	Beever and Brussard 2000, Berger 1985	Increases in shrub cover, reduction plant biomass (Reiner and Urnuss 1982 as cited in Beever and Brussard 2000), direct competition with bighorn sheep and pronghorn antelope (Berger 1985)	Rocky Mountain Alpine-Montane Wet Meadow, Great Basin Springs and Seeps	reduces species richness and height, reduced number of small mammal burrows (Beever and Brussard 2000)	Exotic ungulate (combined livestock grazing with feral horse) grazing can increase negative effects (Beever and Brussard 2000)	x	x	
Transportation infrastructure								
Roads	Nachlinger et al 2001.	"Road-effect zone" includes exotic plant spread, wildlife movement, wildlife death, road salt spread, increase runoff and impair natural water movement, cause water impediment, bird nesting success, bird movement, bird death, increased traffic increases the effect-zone (Forman et al 2003). Increases fragmentation of habitat (WAPT 2006). Within the Great Basin Ecoregion, 44% has no roads, 54% has 1-57 km road per 2000 ha, and 2% has >59 km/2000 ha, Nachlinger et al 2001.	All within the road-effect zone		Surface Flow: Roads act to increase drainage basin network density, channelize flow and increase sedimentation to streams.	x	x	
Transmission corridors	WAPT 2006	Removal of nesting cover, increases travel lanes for predators and perch sites for avian predators (WAPT 2006). Increases fragmentation-- reducing ground nesting species, increases predator pressure (WAPT 2006)	Sagebrush Habitats, Greater Sage-Grouse, Grassland habitats, Forests, shrublands	Increase predation, reduction of nesting cover -- Greater Sage-Grouse (WAPT 2006)	Increased infrastructure and human population growth	x	x	
Railroads	Ito et al.. 2005	Ungulates refuse to cross railroad (Ito et al. 2005)						
Water transmission	J. E. Lovich and D. Bainbridge 1999; Vasek et. al 1975; Artz 1989; Zink et. al 1995;	Partial to complete removal of vegetation, partial to complete destruction of animal habitat, habitat fragmentation, retardation of habitat recovery due to maintenance, corridor expansion for non-native species which thrive on disturbance, extensive trenching and construction of diversion structures	All conservation elements adjacent to and within corridor.	Restricted gene flow as a result of fragmentation, Decrease in wildlife and plant populations due to habitat loss and increased competition by non-native plants. Reduced plant biomass as a result of water diversion.		x	x	
Energy Development								
Extractive energy development								
Oil and Gas	Ingelfinger and Anderson 2004	reduction in 60% sagebrush birds within/ 100 ft of roads (Ingelfinger and Anderson 2004)				x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Gas pipelines	BLM 2010	Proposed Ruby Pipeline Project, a proposed 678 mile interstate natural gas pipeline that crosses 368 miles of Federal land beginning near Opal, Wyoming, through northern Utah and northern Nevada, and terminating near Malin, Oregon may disrupt migration corridors of ungulates	Sage brush, grasslands, others.			x	x	
Mining	Morrison and Fox 2009, Knapp 1992, Bates 1985, Nachlinger et al. 2001	Affects Bat habitat (Morrison and Fox 2009). Soil compaction that lasts >100 years (Knapp 1992). Coal mining disrupts Raptor nesting sites (Bates 1985)	Bats, raptor nest loss	Increases bat habitat, depending on mining practices (Morrison and Fox 2009)		x	x	
Renewable energy development								
Wind	BLM Nevada 2010	Habitat destruction, bird mortality has been documented but effect vary greatly according to the setting of the facility and type of technology used (Barrios & Rodriguez, 2004; Drewitt & Langston, 2006). Some older facilities (Altamont Pass, CA) have high mortality rates (Orloff & Flannery, 1992) while other facilities have very low mortality rates (Osborn et al, 2000)				x	x	
Solar	BLM Nevada, 2010; BLM 2010	Habitat destruction due to clearing and leveling of the site (Hunter et al, 1987). Other potential environmental impacts of solar thermal receivers include: the accidental or emergency release of toxic chemicals used in the heat transfer system (Baechler & Lee 1991); bird collisions with a heliostat and incineration of both birds and insects if they fly into the high temperature portion of the beams; and--if one of the heliostats did not track properly but focused its high temperature beam on humans, other animals, or flammable materials--burns, retinal damage, and fires (Mihlmester et al. 1980). Concern about large quantities of water usage for thermal (steam) solar plants, and for cooling systems have been raised (Beamish, 2009)			Support infrastructure development: roads, power lines.	x	x	
Geothermal	BLM Nevada 2010	Habitat destruction at site (similar to urban development) and water demands (BLM Nevada, 2010)			Support infrastructure development: roads, power lines.	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Biomass	BLM California 2010	The potential for pinyon-juniper forests to provide biomass for energy or carbon conversion is currently being explored in NE California, NW, Central and Eastern Nevada.	Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, Great Basin Pinyon-Juniper Woodland, Inter-Mountain Basins Montane Sagebrush SteppeGreat Basin Pinyon-Juniper Woodland			x	x	
Military constrained areas								
Military use areas	Nachlinger et al. 2001	Off-road mechanized and artillery training activities reduce vegetation cover, disturb crusts, and degrade soils, making the land more vulnerable to wind erosion (Milchunas et al, 2000; Van Donk, 2003); perennial vegetation is negatively impacted (Steiger and Webb, 2000); pollution and contamination from hazardous substances is an issue on some bases (GAO, 1994)				x	x	
Conflict-of-use areas	Pepper et al.. 2003	Low flying aerial activity from military operations generate noise which has been shown to stress some wildlife but not always and not consistently (Weisenberger et al, 1996). Some species such as mountain sheep and prairie falcons have quickly habituated to noise (Krausman et al, 1998; Ellis et al, 1991)				x	x	
Areas of moratoria on LU planning	Danelski 2010	Not documented in Central Basin but DOD has objected to wind farms near military reservations in Mojave basin due to turbines' interference with radar and flight operations				x	x	
Potential military expansion areas	Bauman 2004	Not confirmed but there is speculation that Dugway Proving Ground has plans to expand into BLM managed land (Bauman, 2004)				x	x	
Air and Water Quality								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Atmospheric Deposition	Neff et al. 2008. Fenn et al. 2003; Hageman et al. 2006; Schuster et al. 2002	Dust deposited on mountain snowpack can have an effect on snow–albedo feedback, causing premature melt off (Painter et al. 2007); Direct effect of dust emissions on the respiratory systems of humans (Reheis, 1997). Acidification of soils and water altering soil biological systems and root dynamics; nutrient (N, S) enrichment altering primary production and inter-species plant competition; pesticide contamination (and bioaccumulation) in food webs; mercury contamination of top predators leading to reproductive and behavioral degradation	All Alpine systems	See under "ecological effects"	Off-road vehicle use, exploration and development of energy resources, pipelines, transmission lines, increased use of existing dirt roads facilitates increased dusting and leads to decreased plant biomass and cover (Sharifi et al. 1999); water diversions or the pumping of water from shallow lakes (Blank et al, 1999; Reheis, 1997; Saint Amand et al, 1986). Affected by climate change impacts that alter precipitation form and amounts and alter fog/mist deposition as well. Also affected by proximity of air contamination sources	x	x	
Refuse management	Lee G.F. and Jones-Lee 2005	altering soil composition and permeability, and by providing centers for destructive rodents; pollution of local ground water from refuse disposal (Courtney and Fenton 1976) Storm water runoff from landfill properties can contain a variety of regulated and many unregulated pollutants that are a threat to the health of those who use the treated waters for domestic purposes and to aquatic life (Lee and Jones-Lee 2010). Significant levels of pharmaceuticals in landfill leachate, affecting the neurological controls of many animals including humans. PBDE (polybrominated diphenyl ether) is also ubiquitous.	Federally listed Fish, Mammals, and birds	The wildlife that lives or grazes at the land surface that cove4r landfills are thus exposed to high concentrations of landfill gas and exposure to associated carcinogens (Lee and Jones-Lee 2010). High mercury levels have been found in fish downstream of hazard waste superfund sites (Lee and Jones 2010). Water and dust borne contaminants enter lungs and food chain of animals and humans	environmental justice issue associated with the development of a landfill that will be adverse to minority communities (Lee and Jones-Lee 2010)	x	x	
Hydrologic Alteration								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Groundwater withdrawals	Deacon et al. 2007	Reduce extent of perennial stream flows (gaining stream reaches), increase extent of dry streambeds (losing stream reaches), lower water levels and alter hydrologic regime of springs and seeps; alter alluvial soil moisture regimes in riparian zones	Potentially many lower foothill and basin streams, springs, seeps, depending on what aquifers are involved and proximity to groundwater extraction sites	Altered hydrology leads to degradation of habitat and reduced availability and/or suitability of water bodies for ecosystem support	Effects can be exacerbated by climate change, altered land cover and altered land-use that result in altered aquifer recharge; and by stream incision that drops water table levels along alluvial (riparian) zones	x	x	
Altered Surface Flow Connectivity (dams, alterations to habitat that make stream reaches unsuitable for species movement)	Deacon et al. 2007	Barriers to movement of aquatic fauna and transport of riparian plant propagules can reduce ability of streams to recolonize reaches following disturbance, prevent aquatic animals from completing life-cycle changes	Potentially all stream/river networks subject to dams, diversions, or dry reaches	Same as "ecological effects"	Effects can be exacerbated by other CA that result in presence of dry stream or river reaches, that also act as barriers to biotic movement	x	x	
Altered Surface Flow (flood control, diversions, spring impoundments etc)	Deacon et al. 2007	Altered stream and river flows caused by water diversions and flow manipulation (e.g., storage and release operations) result in diverse ecological consequences that become more severe the greater the degree of alteration of key components of the flow regime (magnitude, frequency, timing, duration of ecological flow components)	All flowing-water systems and any lakes or wetlands for which stream/river inflows determine the hydrologic regime	Same as "ecological effects"	Effects can be exacerbated by groundwater withdrawals, climate change, altered land cover and altered land-use that result in altered watershed rainfall, runoff, infiltration, and detention characteristics	x	x	
Class III Invasive Species								
Terrestrial invasive species								

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Cheat grass (*Bromus tectorum*)	Nachlinger 2001, WAPT 2006,	Changes fire regime, displaces native terrestrial species, can dry surface soils, reduces wildlife habitat (Nachlinger et al. 2001, West and Young 2000, WAPT 2006) Loss of native species richness and abundance may reduce ecosystem resilience and the capacity to adjust to ever-increasing rates of environmental change (Chapin et al. 1997).	Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland; Inter-Mountain Basin Greasewood Flat, Inter-Mountain Basins Mixed Salt Desert Scrub, Inter-Mountain Basins Wash and Inter-Mountain Basins Semi-Desert Scrub Steppe	Inter-Mountain Basins Big Sagebrush Shrubland--Complete elimination of shrub cover by frequent fire (Young and West 2000, WAPT 2006), Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland -- loss of old growth stands (WAPT 2006); Replaces native seed-bearing grasses and forbs-- affects food source for small mammals such as the Dark & Pale Kangaroo mouse (WAPT 2006)	Alters fire regimes, Off-road vehicle use increases exotic invasion	x	x	
Medusa Head (*Taeniantherum caput-medusae)*	Nachlinger et al. 2001.	displaces native species, reduces native wildlife habitat (Nachlinger et al. 2001, Barbour and Major 1977)	Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland; Inter-Mountain Basin Greasewood Flat, Inter-Mountain Basins Mixed Salt Desert Scrub, Inter-Mountain Basins Wash and Inter-Mountain Basins Semi-Desert Scrub Steppe		Alters fire regimes, Off-road vehicle use increases exotic invasion	x	x	
Tamarisk (*Tamarix* spp.)	Nachlinger et al. 2001, WAPT 2006	greater tolerance for alkaline soils, displaces native species, reduces native wildlife habitat (Nachlinger et al. 2001, Stromberg et al. 2009, WAPT 2006)	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland		Floodplain development and water diversions/flood control projects that curtail natural river meander process, Agricultural runoff increasing stream and ground water salinity (Stromberg et al 2009)		x	
Russian Olive *(Elaeagnus angustifolia)*	Nachlinger et al. 2001, WAPT 2006	displaces native species, reduces native wildlife habitat (Chambers and Miller 2004)	Montane Riparian Shrubland and Woodland		Exotic Ungulate Grazing and lowered groundwater tables	x	x	
Native Increasers (e.g. Conifer)	Nachlinger et al. 2001, WAPT 2006	Pinyon-Juniper Woodlands increased tree density, changes vegetation structure for wildlife habitats, reduction of seed-bearing grasses (WAPT 2006), increase in woody density of grassland systems (Nachlinger et al. 2001)	Great Basin Pinyon-Juniper Woodland, Inter-Mountain Basins Semi-Desert Grassland		Altered Fire regime allows for Juniper to increase in density	x	x	
Halogeton (*Halogeton glomeratus)*	Nachlinger et al. 2001, WAPT 2006	Changes soil chemistry, reduces native wildlife habitat, altered species composition and function (Nachlinger et al. 2001, West and Young 2000, WAPT 2006)	Inter-Mountain Basins Playa, and Inter-Mountain Basins Mixed Salt Desert Scrub Ecosystems			x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Tumble mustard (*Sisymbrium altissimum*)	Nachlinger et al. 2001, WAPT 2006	displaces native species, reduces native wildlife habitat (Nachlinger et al. 2001)	Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland, Great Basin Pinyon-Juniper Woodland, Inter-Mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Semi-Desert Grassland, Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland, Great Basin Semi-Desert Chaparral,			x	x	
Russian thistle (*Salsola kali*)	Nachlinger et al. 2001, WAPT 2006	Changes soil chemistry, reduces native wildlife habitat, altered species composition and function (Nachlinger et al. 2001, WAPT 2006)	Inter-Mountain Basins Playa, and Inter-Mountain Basins Mixed Salt Desert Scrub Ecosystems			x	x	
Hardheads (*Acroptilon* spp.)	Nachlinger et al. 2001, WAPT 2006	displaces native species, reduces native wildlife habitat (Nachlinger et al. 2001)				x	x	
Knap weed (*Centaurea* spp.)	Nachlinger et al. 2001, WAPT 2006	displaces native species, reduces native wildlife habitat (Nachlinger et al. 2001)	Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Big Sagebrush Shrubland,			x	x	
Nasturtium officinale	*personal communication*, NV Heritage Wetland Ecologist	"is in nearly every cold water spring in Nevada and it does displace native plant species to some degree but it doesn't seem to have a negative impact on the springsnail populations."	Great Basin Springs and Seeps,			x	x	
non-native thistles	*personal communication*, NV Heritage Wetland Ecologist	Loss of native species richness and abundance may reduce ecosystem resilience and the capacity to adjust to ever-increasing rates of environmental change (Chapin et al. 1997).				x	x	
Aquatic invasive species								
Didymosphenia gemenata (Didymo, rock snot)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Eliminates habitat for majority of native benthic taxa, reduces biodiversity, alters stream hydraulics	Coldwater stream components of Montane aquatic	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature and hydrology	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Apple snails (*Pomacea* sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Compete with natives, alters food webs, potential disease vector	Springs, low-velocity streams and rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
European Ear Snail (*Radix auricularia*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Compete with natives, alters food webs, potential disease vector	Lakes, springs, slow-moving rivers with mud bottoms	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature, sedimentation and hydrology	x	x	
Red-rim melania (*Melanoides tuberculatus*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Competes with natives, alters food webs, potential disease vector; see also Benson 2010	Warmwater streams; tolerates brackish and low-DO waters	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	x	x	
New Zealand mudsnail (*Potamopyrus antipodarum*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Competes with natives, alters food webs, potential disease vector	Streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
Chinese mystery snail *(Cipangopaludina chinensis malleata)*	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al.	Competes with natives, alters food webs, potential disease vector	Lakes, springs, slow-moving rivers with mud bottoms	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
	2002							
Quagga mussel (*Dreissena* sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupts primary and secondary production, alters food webs and water chemistry, indirect effects, trophic cascades	Warm-water lakes, springs, slow-moving rivers	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	x	x	
Zebra mussel (*Dreissena* sp)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupts primary and secondary production, alters food webs, indirect effects, trophic cascades	Lakes, springs, slow-moving rivers	See under "ecological effects"	Adds to and could enhance effects of climate change and other causes of altered water temperature, water quality, sedimentation and hydrology	x	x	
Asian clam (*Corbicula fluminea)*	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alters food webs, indirect effects, trophic cascades	Streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
African clawed frog (*Xenopus laevis*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alters food webs, indirect effects, trophic cascades	Lakes, wetlands, springs	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
Crayfish sp.	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Disrupt primary and secondary production, alter food webs, indirect effects, trophic cascades	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
Mollies and guppies (*Poecilia* sp.)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Unknown	See under "ecological effects"	Unknown	x	x	
Tilapia (*Oreochromis* sp)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
Gizzard shad	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al. 2002	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	
Asian or European carp (Family *Cyprinidae*)	Enserink 1999; Erman 2002; Hall et al. 2006; Hershler and Sada 2002; Sada et al. 2001; Shepard 1993; Spaulding and Elwell 2007; Thomson et al.	Alter food webs, compete with native endemic fish	Lakes, streams, rivers	See under "ecological effects"	Adds to effects of climate change and other causes of altered water temperature and hydrology	x	x	

Change Agent	Source	Ecological Effects	Conservation Elements Affected	Effects to Conservation Elements	Change Agent Synergies	Current	Future	Include
	2002							
Class IV Climate Change								
Temperature change	BLM 2008; Breshears et al. 2007; Dale et al. 2001; Epps et al. 2004; Lenart et al. 2007; Maurer et al. 2007; Moriz 2008, Parmesan and Yohe 2003; Seager et al. 2007; Thomas et al. 2004; USGCRP 2009; Smith et al. 2000 see also Memorandum Text Narrative	Range expansion at lower elevations and range contraction in alpine zones of small mammals with temp increase on 3 C (Moritz 2008); Range shifts among plants, other animals; Increased evaporation and transpiration leading to declining soil moisture and increased drought stress in plants; lower snowpack and earlier snowmelt will both lead to changes in hydrological patterns	Ground squirrels, shrews, voles; all ecological systems	species declines, sedimentation, species invasions, disease; range shifts among plants, animals;insect infestations in pine and mixed-conifer forests	Climate change stress across the Central Basin is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts; climate change, invasive species, wildfire, and native species decline has already developed in much of the southwestern U.S. and is expected to continue to worsen	x	x	
Precipitation Change	BLM 2008; Breshears et al. 2007; Dale et al. 2001; Epps et al. 2004; Lenart et al. 2007; Maurer et al. 2007; Parmesan and Yohe 2003; Seager et al. 2007; Thomas et al. 2004; USGCRP 2009; Smith et al. 2000	The Central Basin is expected to become drier, however, even with some seasonal increases in precipitation; precipitation is expected to increasingly fall as rain instead of snow; intensified water cycle, there is an increased likelihood of flooding	All ecological systems, species.	species declines, sedimentation, species invasions, disease; range shifts among plants, animals;insect infestations in pine and mixed-conifer forests	Climate change stress across the Central Basin is expected to act synergistically with other stress to the landscape and the ecological systems of the area to exacerbate species declines, sedimentation, species invasions, disease, and other impacts; climate change, invasive species, wildfire, and native species decline has already developed in much of the southwestern U.S. and is expected to continue to worsen	x	x	

Appendix 4a. Master List of Candidate Species for the Central Basin and Range Ecoregion under criteria a-b.

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Amphibians	Inyo Mountains Salamander	*Batrachoseps campi*	G2		No	CA	19	No
A	Amphibians	Kern Plateau Salamander	*Batrachoseps robustus*	G2		No	CA	3	No
A	Amphibians	Western Toad	*Bufo boreas*	G4		Yes	AK, MT, OR, UT, WA	144	No
A	Amphibians	Yosemite Toad	*Bufo canorus*	G2	C	No	CA	59	No
A	Amphibians	Great Plains Toad	*Bufo cognatus*	G5		Yes	IA, MO, NV, UT, WY	1	No
A	Amphibians	Black Toad	*Bufo exsul*	G1		Yes	CA	6	Yes
A	Amphibians	Arizona Toad	*Bufo microscaphus*	G3		Yes	AZ, NM, NV, UT	88	No
A	Amphibians	Amargosa Toad	*Bufo nelsoni*	G2		Yes	NV	23	No
A	Amphibians	Mount Lyell Salamander	*Hydromantes platycephalus*	G3		No	CA	12	No
A	Amphibians	Owens Valley Web-toed Salamander	*Hydromantes sp. 1*	G1		No	CA	2	Yes
A	Amphibians	Columbia Spotted Frog	*Rana luteiventris*	G4		Yes	AK, ID, NV, OR, UT, WA, WY	160	No
A	Amphibians	Columbia Spotted Frog - Great Basin	*Rana luteiventris pop. 3*	T2	C	Yes		303	No
A	Amphibians	Southern Mountain Yellow-legged Frog	*Rana muscosa*	G2	PS:LE,C	No	CA		Yes
A	Amphibians	Mountain Yellow-legged Frog	*Rana muscosa*	G2		No			Yes
A	Amphibians	Relict Leopard Frog	*Rana onca*	G1	C	Yes	AZ, NV, UT	6	No
A	Amphibians	Northern Leopard Frog	*Rana pipiens*	G5		Yes	AZ, CA, CO, CT, ID, IN, KY, MA, MI, MO, MT, NH, NM, NV, OR, PA, RI, UT, WA, WV, WY	164	No
A	Amphibians	Sierra Nevada Yellow-legged Frog	*Rana sierrae*	G1		No	NV	58	No
A	Ants, Wasps, and Bees	Lassen Chrysidid Wasp	*Argochrysis lassenae*	G1		No		1	No
A	Ants, Wasps, and Bees	A Montane Ant	*Formica microphthalma*	G2		No		2	No
A	Ants, Wasps, and Bees	Dune Honey Ant	*Myrmecocystus snellingi*	G2		No		4	Yes
A	Ants, Wasps, and Bees	Borrego Parnopes Chrysidid Wasp	*Parnopes borregoensis*	G1		No		1	No
A	Ants, Wasps, and Bees	An Ant	*Stenamma wheelerorum*	G1		No		1	No
A	Birds	Cooper's Hawk	*Accipiter cooperii*	G5		Yes	CA, CT, DE, MI, NC, NE, NH, NJ, NY, VT, WV	1	Yes
A	Birds	Northern Goshawk	*Accipiter gentilis*	G5		Yes	AK, AK, CA, CO, CT, MD, MI, MN, NH, NJ, NM, NV, NY, OR, PA, RI, SD, UT, VT, WA, WI, WV, WY	163	Yes
A	Birds	Tricolored Blackbird	*Agelaius tricolor*	G2		Yes	CA, NV, WA	2	No
A	Birds	Grasshopper Sparrow	*Ammodramus savannarum*	G5		Yes	AR, AZ, CA, CT, DC, DE, FL, GA, IA, ID, IL, KS, KY, LA, MA, MD, ME, MI, MN, MS, NC, ND, NH, NJ, NM, NY, OR, PA, RI, SC, TN, TX, UT, VA, VT, WA, WI, WV, WY	12	No
A	Birds	Sage Sparrow	*Amphispiza belli*	G5		Yes	CO, NM, NV, OR, UT, WA, WY	13	Yes
A	Birds	Golden Eagle	*Aquila chrysaetos*	G5		Yes	AK, CA, CO, KS, MD, ME, ND, NE, NH, NM, NY, PA, TN, TX, WA	9	No
A	Birds	Great Egret	*Ardea alba*	G5		Yes	AZ, CA, CT, DE, ID, IL, IN, KS, KY, MD, ME, MO, NJ, NY, OH, PA, RI, SC, TN, WA, WI	5	No
A	Birds	Short-eared Owl	*Asio flammeus*	G5		Yes	AK, AL, AR, CA, CO, CT, DE, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, ND, NE, NJ, NV, NY, OK, OR, PA, RI, TN, TX, UT, VT, WA, WI, WV, WY	84	No
A	Birds	Long-eared Owl	*Asio otus*	G5		Yes	CA, CT, DE, IA, KY, MA, MD, ME, MI, MO, NE, NJ, NY,	9	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
							PA, RI, VT, WV		
A	Birds	Burrowing Owl	*Athene cunicularia*	G4		Yes	CA, CO, IA, ID, KS, MN, MT, ND, NE, NM, OK, SD, TX, UT, WA, WY	496	No
A	Birds	Western Burrowing Owl	*Athene cunicularia hypugaea*	T4		Yes	NV, OR	5	No
A	Birds	Redhead	*Aythya americana*	G5		Yes	DE, IA, LA, ND, NV, SC, TX, VA, WA, WI, WY		Yes
A	Birds	Juniper Titmouse	*Baeolophus ridgwayi*	G5		Yes	CO, ID, NM, OK, OR, WY		Yes
A	Birds	Cattle Egret	*Bubulcus ibis*	G5		Yes	AZ, DE, ID, ME, NJ, NY, RI	1	No
A	Birds	Ferruginous Hawk	*Buteo regalis*	G4		Yes	AZ, CA, CO, ID, KS, ND, NE, NM, NV, OK, OR, SD, TX, UT, WA, WY	680	Yes
A	Birds	Swainson's Hawk	*Buteo swainsoni*	G5		Yes	AK, CA, CO, IA, ID, IL, KS, MN, MO, ND, NE, NV, OK, OR, TX, WA, WY	389	Yes
A	Birds	Common Black-Hawk	*Buteogallus anthracinus*	G4		Yes	AZ, NM, TX	3	No
A	Birds	Green Heron	*Butorides virescens*	G5		Yes	CT, MA, MI, NJ, SC, VA, WA	3	No
A	Birds	Lark Bunting	*Calamospiza melanocorys*	G5		Yes	CO, KS, ND, SD, WY	13	No
A	Birds	Costa's Hummingbird	*Calypte costae*	G5		Yes	CA, NM, NV	4	No
A	Birds	Turkey Vulture	*Cathartes aura*	G5		Yes	WA	7	No
A	Birds	Veery	*Catharus fuscescens*	G5		Yes	CO, CT, DE, IA, MD, ME, MN, NJ, VT, WA, WI	11	No
A	Birds	Greater Sage-Grouse	*Centrocercus urophasianus*	G4		Yes	CA, CO, ID, MT, ND, NE, NV, OR, SD, UT, WA, WY	73	Yes
A	Birds	Snowy Plover	*Charadrius alexandrinus*	G4		Yes	AL, KS, LA, NM, OK, TN, TX, UT	33	No
A	Birds	Western Snowy Plover	*Charadrius alexandrinus nivosus*	T3		Yes	AZ, CA, CO, NV, OR, WA	28	Yes
A	Birds	Mountain Plover	*Charadrius montanus*	G3	PT	Yes	AZ, CA, CO, KS, MT, NE, NM, OK, TX, UT, WY	10	No
A	Birds	Black Tern	*Chlidonias niger*	G4		Yes	CA, DE, IA, ID, IL, IN, KS, KY, MD, ME, MI, MN, MO, MT, ND, NE, NJ, NV, NY, PA, SD, VT, WA, WI, WY	7	No
A	Birds	Lesser Nighthawk	*Chordeiles acutipennis*	G5		Yes		10	No
A	Birds	Northern Harrier	*Circus cyaneus*	G5		Yes	AK, AL, AR, AZ, CA, CO, CT, DE, IA, IL, IN, KY, LA, MA, MD, MI, MN, MO, NC, ND, NE, NH, NJ, NM, NY, PA, RI, TN, TX, VA, VT, WI, WV	3	Yes
A	Birds	Evening Grosbeak	*Coccothraustes vespertinus*	G5		Yes	AZ, CO, MI	9	No
A	Birds	Yellow-billed Cuckoo	*Coccyzus americanus*	G5		Yes	AR, CO, CT, IA, ID, IL, LA, MI, NC, NE, NJ, NM, RI, TN, TX, UT, VA, WA, WI, WY	38	No
A	Birds	Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	T3	C	Yes	AZ, CA, NV	22	Yes
A	Birds	Inca Dove	*Columbina inca*	G5		Yes		1	No
A	Birds	Trumpeter Swan	*Cygnus buccinator*	G4		Yes	AR, IA, ID, IL, IN, KY, MI, MN, MO, MT, NE, OK, SD, WA, WI, WY	10	No
A	Birds	Black Swift	*Cypseloides niger*	G4		Yes	AK, AK, CA, CO, ID, NM, OR, UT, WA	13	No
A	Birds	Bobolink	*Dolichonyx oryzivorus*	G5		Yes	CO, CT, DC, DE, IA, IL, KS, KY, MD, ME, MI, MN, NC, ND, NJ, NV, NY, OH, OR, PA, RI, UT, VT, WA, WI, WV, WY	39	No
A	Birds	Gray Catbird	*Dumetella carolinensis*	G5		Yes	AZ, CT, NJ, RI, VA	6	No
A	Birds	Snowy Egret	*Egretta thula*	G5		Yes	AR, AZ, CA, CO, CT, DE, FL, ID, IL, KS, MA, MD, ME, MO, MS, NC, NJ, NV, NY, OK, OR, RI, SC, TX, WI, WY	1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Birds	Willow Flycatcher	*Empidonax traillii*	G5		Yes	AR, CA, CT, DE, IA, KY, MA, MD, ME, MN, NC, NJ, NY, OK, PA, RI, VA, WA, WI, WY	15	No
A	Birds	Southwestern Willow Flycatcher	*Empidonax traillii extimus*	T1	LE	Yes	AZ, CA, CO, NM, NV, UT	21	Yes
A	Birds	Gray Flycatcher	*Empidonax wrightii*	G5		Yes	CO, WA	10	Yes
A	Birds	Merlin	*Falco columbarius*	G5		Yes	AK, AK, CA, FL, ID, MI, NE, TX, WA, WY	1	No
A	Birds	Prairie Falcon	*Falco mexicanus*	G5		Yes	CA, CO, ND, NE, OK, TX, WA	36	Yes
A	Birds	Peregrine Falcon	*Falco peregrinus*	G4		Yes	AK, CT, DE, FL, IA, ID, IL, IN, KS, KY, MA, ME, MI, MN, MO, NC, ND, NE, NH, NJ, NM, NV, NY, OK, PA, RI, SC, SD, TN, UT, VA, VT, WA, WI, WV, WY	163	Yes
A	Birds	American Peregrine Falcon	*Falco peregrinus anatum*	T4		Yes	AK, AZ, CA, CO, MD, OR, TX	2	No
A	Birds	Common Moorhen	*Gallinula chloropus*	G5		Yes	AR, CT, IA, IL, IN, KY, MA, MD, ME, MI, MN, MO, NC, NH, OH, PA, RI, WV	4	No
A	Birds	Common Loon	*Gavia immer*	G5		Yes	AK, CA, CT, FL, ID, MA, MD, ME, MI, MN, MT, NH, NV, NY, SC, VT, WA, WY	2	No
A	Birds	Greater Roadrunner	*Geococcyx californianus*	G5		Yes	MO	2	No
A	Birds	Common Yellowthroat	*Geothlypis trichas*	G5		Yes	RI, TX	40	No
A	Birds	Whooping Crane	*Grus americana*	G1	LE, XN	Yes	CO, FL, IA, IL, IN, KS, KY, LA, MT, ND, NE, OK, SD, TN, TX, UT, WI	1	No
A	Birds	Sandhill Crane	*Grus canadensis*	G5		Yes	IA, ID, IL, IN, LA, ME, MO, NE, NM, OK, WA, WY	3	Yes
A	Birds	Greater Sandhill Crane	*Grus canadensis tabida*	T4		Yes	CA, CO, NV, OR	23	No
A	Birds	Pinyon Jay	*Gymnorhinus cyanocephalus*	G5		Yes	CO, ID, NE, NM, NV, OK	11	Yes
A	Birds	Bald Eagle	*Haliaeetus leucocephalus*	G5		Yes	AK, AK, AR, AZ, CA, CO, CT, DC, DE, FL, GA, IA, ID, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NH, NJ, NM, NV, NY, OK, OR, PA, RI, SC, SD, TN, TX, UT, VA, VT, WA, WI, WV, WY	888	No
A	Birds	Black-necked Stilt	*Himantopus mexicanus*	G5		Yes	DE, GA, ID, KS, NC, NE, NV, OR, TX, UT, WA	10	No
A	Birds	Harlequin Duck	*Histrionicus histrionicus*	G4		Yes	CA, ID, MA, MD, ME, MT, NY, RI, WA, WY	4	No
A	Birds	Caspian Tern	*Hydroprogne caspia*	G5		Yes	AK, CA, FL, ID, LA, MI, NC, NJ, NY, OR, UT, WA, WI, WY	12	No
A	Birds	Yellow-breasted Chat	*Icteria virens*	G5		Yes	CA, CT, DE, IA, IL, MI, NE, NJ, NY, OR, PA, RI, VA, WA	7	Yes
A	Birds	Hooded Oriole	*Icterus cucullatus*	G5		Yes	NM, TX	2	No
A	Birds	Scott's Oriole	*Icterus parisorum*	G5		Yes	NV, TX, WY	1	No
A	Birds	Least Bittern	*Ixobrychus exilis*	G5		Yes	AL, AR, CA, CT, DC, DE, FL, GA, IA, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MS, NC, NE, NH, NJ, NY, PA, RI, SC, TN, TX, VA, VT, WV	5	Yes
A	Birds	Western Least Bittern	*Ixobrychus exilis hesperis*	T3		Yes	NV	3	No
A	Birds	Loggerhead Shrike	*Lanius ludovicianus*	G4		Yes	CA, CO, DE, FL, IA, IL, IN, KS, KY, LA, MD, ME, MN, MO, MS, NC, ND, NE, NJ, NM, NV, NY, OK, OR, PA, SC, TN, TX, VA, WA, WI		Yes
A	Birds	California Gull	*Larus californicus*	G5		Yes	AK, CA, ID	2	Yes
A	Birds	Franklin's Gull	*Leucophaeus pipixcan*	G4		Yes	ID, MN, ND, NV, OR, WA, WY	1	Yes
A	Birds	Black Rosy-finch	*Leucosticte atrata*	G4		Yes	CO, ID, NV, UT, WY		Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Birds	Lewis's Woodpecker	*Melanerpes lewis*	G4		Yes	AZ, CA, CO, ID, KS, NE, NM, NV, OK, OR, SD, UT, WA, WY	34	Yes
A	Birds	Common Merganser	*Mergus merganser*	G5		Yes	AZ, CT, WA	1	No
A	Birds	Wood Stork	*Mycteria americana*	G4		Yes	AL, AR, CA, FL, GA, LA, MS, NC, OK, SC, TX	2	No
A	Birds	Brown-crested Flycatcher	*Myiarchus tyrannulus*	G5		Yes	CA	2	No
A	Birds	Painted Redstart	*Myioborus pictus*	G5		Yes	NM	1	No
A	Birds	Long-billed Curlew	*Numenius americanus*	G5		Yes	CA, CO, ID, KS, MT, ND, NE, NM, NV, OK, OR, SC, SD, TX, UT, WA, WY	216	Yes
A	Birds	Black-crowned Night-Heron	*Nycticorax nycticorax*	G5		Yes	AR, CA, CT, DC, DE, FL, IA, ID, IL, IN, KS, KY, MA, MD, ME, MI, MN, MO, MS, NE, NJ, NY, PA, RI, SC, VA, VT, WA, WV, WY	2	No
A	Birds	Mountain Quail	*Oreortyx pictus*	G5		Yes	ID, NV, OR, WA	9	No
A	Birds	Sage Thrasher	*Oreoscoptes montanus*	G5		Yes	AZ, NE, NM, UT, WA, WY	1	Yes
A	Birds	Flammulated Owl	*Otus flammeolus*	G4		Yes	CA, CO, ID, MT, OR, TX, WA	19	Yes
A	Birds	Osprey	*Pandion haliaetus*	G5		Yes	AK, AK, AR, AZ, CA, CO, CT, DE, IA, IL, IN, KY, MI, MO, MS, NH, NJ, NM, NY, PA, RI, SD, UT, VT, WA, WI, WV	48	No
A	Birds	Blue Grosbeak	*Passerina caerulea*	G5		Yes	ID	39	Yes
A	Birds	Band-tailed Pigeon	*Patagioenas fasciata*	G4		Yes	AK, CO, NM, OR, TX, UT, WA	50	No
A	Birds	American White Pelican	*Pelecanus erythrorhynchos*	G4		Yes	AR, CA, CO, DE, IA, ID, KS, KY, MI, MN, MS, ND, NE, NV, OR, SD, TX, UT, WA, WY	79	Yes
A	Birds	Brown Pelican	*Pelecanus occidentalis*	G4		Yes		1	No
A	Birds	Phainopepla	*Phainopepla nitens*	G5		Yes	NV, TX	7	No
A	Birds	Wilson's Phalarope	*Phalaropus tricolor*	G5		Yes	AR, CO, DE, IA, ID, IL, KS, KY, MI, MN, ND, NJ, NM, OK, SD, TX, WA, WI		Yes
A	Birds	American Three-toed Woodpecker	*Picoides dorsalis*	G5		Yes	AK, AZ, CO, ID, ME, NH, NY, OR, SD, UT, WA, WY	16	No
A	Birds	Ladder-backed Woodpecker	*Picoides scalaris*	G5		Yes	KS, TX	2	No
A	Birds	Abert's Towhee	*Pipilo aberti*	G3		Yes	CA, NM, NV, UT	9	No
A	Birds	Summer Tanager	*Piranga rubra*	G5		Yes	CA, MD, NE, NJ, PA	3	No
A	Birds	White-faced Ibis	*Plegadis chihi*	G5		Yes	CA, CO, ID, NE, NM, NV, TX, WY	5	Yes
A	Birds	Horned Grebe	*Podiceps auritus*	G5		Yes	AK, CT, DE, FL, KY, MD, MN, ND, NJ, NY, SC, TX, VA, WA, WI		Yes
A	Birds	Eared Grebe	*Podiceps nigricollis*	G5		Yes	AZ, CO, KS, MN, NM, NV, TX, WA	1	No
A	Birds	Black-tailed Gnatcatcher	*Polioptila melanura*	G5		Yes	CA, TX	2	No
A	Birds	Purple Martin	*Progne subis*	G5		Yes	AZ, CA, CO, CT, ME, MI, NH, OR, RI, VT, WA	10	No
A	Birds	Vermilion Flycatcher	*Pyrocephalus rubinus*	G5		Yes	CA	6	No
A	Birds	Common Grackle	*Quiscalus quiscula*	G5		Yes		2	No
A	Birds	American Avocet	*Recurvirostra americana*	G5		Yes	AR, AZ, FL, IA, ID, KS, MN, ND, NE, NV, SC, TX, UT, WA	40	Yes
A	Birds	Bank Swallow	*Riparia riparia*	G5		Yes	AK, CA, CT, DE, KY, MD, NM, PA, RI, TN, WV	9	No
A	Birds	Black Phoebe	*Sayornis nigricans*	G5		Yes	NV	4	No
A	Birds	Broad-tailed Hummingbird	*Selasphorus platycercus*	G5		Yes	CO, UT	2	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Birds	American Redstart	*Setophaga ruticilla*	G5		Yes	AK, CT, DE, IL, MD, TX	10	No
A	Birds	Williamson's Sapsucker	*Sphyrapicus thyroideus*	G5		Yes	CO, NM, UT, WA	5	No
A	Birds	Brewer's Sparrow	*Spizella breweri*	G5		Yes	CA, CO, ID, ND, NE, NV, OR, TX, UT, WA, WY	9	Yes
A	Birds	Calliope Hummingbird	*Stellula calliope*	G5		Yes	WA		Yes
A	Birds	Forster's Tern	*Sterna forsteri*	G5		Yes	CA, CO, DE, IA, ID, IL, KS, LA, MD, MI, MN, NE, NJ, NV, NY, SC, TX, VA, WA, WI, WY	1	No
A	Birds	Great Gray Owl	*Strix nebulosa*	G5		Yes	AK, CA, OR, WA, WY	10	No
A	Birds	Spotted Owl	*Strix occidentalis*	G3		Yes	TX	4	No
A	Birds	California Spotted Owl	*Strix occidentalis occidentalis*	T3		Yes	CA, NV	3	No
A	Birds	Bendire's Thrasher	*Toxostoma bendirei*	G4		Yes	CA, NM, NV, UT	2	No
A	Birds	Crissal Thrasher	*Toxostoma crissale*	G5		Yes	CA, NV, TX, UT	3	No
A	Birds	Le Conte's Thrasher	*Toxostoma lecontei*	G4		Yes	AZ, CA, NV	2	No
A	Birds	American Robin	*Turdus migratorius*	G5		Yes	AK	1	No
A	Birds	Sharp-tailed Grouse	*Tympanuchus phasianellus*	G4		Yes	IA, ID, MI, MN, ND, UT, WA, WI, WY	127	No
A	Birds	Columbian Sharp-tailed Grouse	*Tympanuchus phasianellus columbianus*	T3		Yes	CA, CO, MT, NV	74	No
A	Birds	Eastern Kingbird	*Tyrannus tyrannus*	G5		Yes	AK, CT, DE, KS, ME, MI, NC, NJ, RI, TX, VA	18	No
A	Birds	Cassin's Kingbird	*Tyrannus vociferans*	G5		Yes	NE, TX	2	No
A	Birds	Virginia's Warbler	*Vermivora virginiae*	G5		Yes	CA, CO, ID, NV, TX, UT	1	Yes
A	Birds	Bell's Vireo	*Vireo bellii*	G5		Yes	AR, IA, IL, KS, KY, LA, MN, NE, NM, OK, TN, TX, UT, WI	1	No
A	Birds	Least Bell's Vireo	*Vireo bellii pusillus*	T2	LE	Yes	CA	3	No
A	Birds	Gray Vireo	*Vireo vicinior*	G4		Yes	CA, CO, NM, NV, TX, UT	1	No
A	Birds	Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	G5		Yes	CA, IL, IN, MI, MO	1	No
A	Birds	White-winged Dove	*Zenaida asiatica*	G5		Yes		1	No
A	Butterflies and Skippers	Desert Green Hairstreak	*Callophrys comstocki*	G2		No		1	No
A	Butterflies and Skippers	Mcneill's Saltbush Sootywing	*Hesperopsis gracielae*	G2		No		1	No
A	Butterflies and Skippers	San Emigdio Blue	*Plebulina emigdionis*	G2		No		1	No
A	Butterflies and Skippers	Carson Wandering Skipper	*Pseudocopaeodes eunus obscurus*	T1	LE	No		22	Yes
A	Butterflies and Skippers	Nokomis Fritillary	*Speyeria nokomis*	G3		No		3	No
A	Caddisflies	Denning's Cryptic Caddisfly	*Cryptochia denningi*	G1		No		1	No
A	Fairy, Clam, and Tadpole Shrimps	Mono Lake Brine Shrimp	*Artemia monica*	G1		No		1	Yes
A	Freshwater and Anadromous Fishes	Desert Sucker	*Catostomus clarkii*	G3		Yes		172	Yes
A	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*	T1		Yes		10	Yes
A	Freshwater and Anadromous Fishes	Meadow Valley Wash Desert Sucker	*Catostomus clarkii ssp. 2*	T2		Yes		12	Yes
A	Freshwater and Anadromous Fishes	Bluehead Sucker	*Catostomus discobolus*	G4		Yes		7	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Freshwater and Anadromous Fishes	Owens Sucker	*Catostomus fumeiventris*	G3		No		19	Yes
A	Freshwater and Anadromous Fishes	Flannelmouth Sucker	*Catostomus latipinnis*	G3		Yes		45	No
A	Freshwater and Anadromous Fishes	Cui-ui	*Chasmistes cujus*	G1	LE	Yes		1	Yes
A	Freshwater and Anadromous Fishes	June Sucker	*Chasmistes liorus*	G1	LE	Yes		10	Yes
A	Freshwater and Anadromous Fishes	White River Sculpin	*Cottus sp. 3*	G1		No		1	Yes
A	Freshwater and Anadromous Fishes	Preston White River Springfish	*Crenichthys baileyi albivallis*	T1		Yes		6	Yes
A	Freshwater and Anadromous Fishes	White River Springfish	*Crenichthys baileyi baileyi*	T1	LE	Yes		2	No
A	Freshwater and Anadromous Fishes	Hiko White River Springfish	*Crenichthys baileyi grandis*	T1	LE	Yes		3	Yes
A	Freshwater and Anadromous Fishes	Moorman White River Springfish	*Crenichthys baileyi thermophilus*	T1		Yes		3	Yes
A	Freshwater and Anadromous Fishes	Railroad Valley Springfish	*Crenichthys nevadae*	G2	LT	Yes		18	Yes
A	Freshwater and Anadromous Fishes	Owens River Pupfish	*Cyprinodon radiosus*	G1	LE	Yes		17	Yes
A	Freshwater and Anadromous Fishes	Pahrump Poolfish	*Empetrichthys latos latos*	T1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Desert Dace	*Eremichthys acros*	G1	LT	Yes		11	Yes
A	Freshwater and Anadromous Fishes	Alvord Chub	*Gila alvordensis*	G2		No		2	No
A	Freshwater and Anadromous Fishes	Fish Creek Springs Tui Chub	*Gila bicolor euchila*	T1		Yes		1	No
A	Freshwater and Anadromous Fishes	Independence Valley Tui Chub	*Gila bicolor isolata*	T1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Newark Valley Tui Chub	*Gila bicolor newarkensis*	T1		Yes		21	Yes
A	Freshwater and Anadromous Fishes	Lahontan Creek Tui Chub	*Gila bicolor obesa*	T4		Yes		6	No
A	Freshwater and Anadromous Fishes	Owens Tui Chub	*Gila bicolor snyderi*	T1	LE	Yes		16	Yes
A	Freshwater and Anadromous Fishes	Fish Lake Valley Tui Chub	*Gila bicolor ssp. 4*	T1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Hot Creek Valley Tui Chub	*Gila bicolor ssp. 5*	T1		Yes		4	No
A	Freshwater and Anadromous Fishes	Little Fish Lake Valley Tui Chub	*Gila bicolor ssp. 6*	T1		Yes		1	Yes
A	Freshwater and	Railroad Valley Tui Chub	*Gila bicolor ssp. 7*	T1		Yes		7	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
	Anadromous Fishes								
A	Freshwater and Anadromous Fishes	Big Smokey Valley Tui Chub	*Gila bicolor ssp. 8*	T1		Yes		5	Yes
A	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*	G1	LE	Yes		2	No
A	Freshwater and Anadromous Fishes	Roundtail Chub	*Gila robusta*	G3		Yes		10	No
A	Freshwater and Anadromous Fishes	A Roundtail Chub	*Gila robusta jordani*	T1	LE	Yes		5	No
A	Freshwater and Anadromous Fishes	Virgin River Chub	*Gila seminuda*	G1	LE	Yes		31	No
A	Freshwater and Anadromous Fishes	Least Chub	*Iotichthys phlegethontis*	G1		Yes		53	Yes
A	Freshwater and Anadromous Fishes	White River Spinedace	*Lepidomeda albivallis*	G1	LE	Yes		8	Yes
A	Freshwater and Anadromous Fishes	Southern Leatherside Chub	*Lepidomeda aliciae*	G2		Yes		61	No
A	Freshwater and Anadromous Fishes	Northern Leatherside Chub	*Lepidomeda copei*	G1		Yes		1	Yes
A	Freshwater and Anadromous Fishes	Virgin Spinedace	*Lepidomeda mollispinis*	G1		Yes		109	Yes
A	Freshwater and Anadromous Fishes	Virgin River Spinedace	*Lepidomeda mollispinis mollispinis*	T1		Yes		2	No
A	Freshwater and Anadromous Fishes	Big Spring Spinedace	*Lepidomeda mollispinis pratensis*	T1	LT	Yes		3	Yes
A	Freshwater and Anadromous Fishes	Moapa Dace	*Moapa coriacea*	G1	LE	Yes		2	No
A	Freshwater and Anadromous Fishes	Lahontan Cutthroat Trout	*Oncorhynchus clarkii henshawi*	T3	LT	Yes		149	Yes
A	Freshwater and Anadromous Fishes	Paiute Cutthroat Trout	*Oncorhynchus clarkii seleniris*	T1	LT	No		10	Yes
A	Freshwater and Anadromous Fishes	Bonneville Cutthroat Trout	*Oncorhynchus clarkii utah*	T4		Yes		197	Yes
A	Freshwater and Anadromous Fishes	Inland Redband Trout and Redband Steelhead	*Oncorhynchus mykiss gairdneri*	T4		Yes		1	No
A	Freshwater and Anadromous Fishes	Woundfin	*Plagopterus argentissimus*	G1	LE, XN	Yes		29	No
A	Freshwater and Anadromous Fishes	Relict Dace	*Relictus solitarius*	G2		Yes		49	Yes
A	Freshwater and Anadromous Fishes	Speckled Dace	*Rhinichthys osculus*	G5	PS	No		189	Yes
A	Freshwater and Anadromous Fishes	Big Smokey Valley Speckled Dace	*Rhinichthys osculus lariversi*	T1		Yes		4	Yes
A	Freshwater and Anadromous Fishes	Independence Valley Speckled Dace	*Rhinichthys osculus lethoporus*	T1	LE	Yes		1	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Freshwater and Anadromous Fishes	Clover Valley Speckled Dace	*Rhinichthys osculus oligoporus*	T1	LE	Yes		4	Yes
A	Freshwater and Anadromous Fishes	Lahontan Speckled Dace	*Rhinichthys osculus robustus*	T5		Yes			Yes
A	Freshwater and Anadromous Fishes	Pahranagat Speckled Dace	*Rhinichthys osculus velifer*	T1		Yes		6	No
A	Freshwater and Anadromous Fishes	A Speckled Dace	*Rhinichthys sp. 3*	G1		No		3	No
A	Freshwater and Anadromous Fishes	Bull Trout	*Salvelinus confluentus*	G3		Yes		1	No
A	Freshwater Mussels	California Floater	*Anodonta californiensis*	G3		Yes		16	Yes
A	Freshwater Mussels	Western Pearlshell	*Margaritifera falcata*	G4		Yes		3	No
A	Freshwater Snails	Badwater Snail	*Assiminea infima*	G1		No		1	No
A	Freshwater Snails	Steptoe Hydrobe	*Eremopyrgus eganensis*	G1		No		4	Yes
A	Freshwater Snails	Green River Pebblesnail	*Fluminicola coloradoensis*	G2		No		5	No
A	Freshwater Snails	Pyramid Lake Pebblesnail	*Fluminicola dalli*	G1		No		2	Yes
A	Freshwater Snails	Pinhead Pebblesnail	*Fluminicola sp. 21*	G1		No			Yes
A	Freshwater Snails	Virginia Mountains Pebblesnail	*Fluminicola virginius*	G1		No		1	Yes
A	Freshwater Snails	Deep Springs Snail	*Fontelicella sp. 6*	G1		No		1	No
A	Freshwater Snails	Great Basin Rams-horn	*Helisoma newberryi*	G1		No		1	No
A	Freshwater Snails	Utah Physa	*Physa gyrina utahensis*	T2		Yes		6	Yes
A	Freshwater Snails	Cloaked Physa	*Physa megalochlamys*	G3		Yes		1	Yes
A	Freshwater Snails	Lamb Rams-horn	*Planorbella oregonensis*	G1		No		1	No
A	Freshwater Snails	Benton Valley Springsnail	*Pyrgulopsis aardahli*	G1		No		1	Yes
A	Freshwater Snails	Duckwater Pyrg	*Pyrgulopsis aloba*	G1		No		2	Yes
A	Freshwater Snails	Southern Duckwater Pyrg	*Pyrgulopsis anatina*	G1		No		1	Yes
A	Freshwater Snails	Longitudinal Gland Pyrg	*Pyrgulopsis anguina*	G1		Yes		3	Yes
A	Freshwater Snails	Elongate Cain Spring Pyrg	*Pyrgulopsis augustae*	G1		No		1	Yes
A	Freshwater Snails	Pleasant Valley Pyrg	*Pyrgulopsis aurata*	G1		No		1	Yes
A	Freshwater Snails	Large Gland Carico Pyrg	*Pyrgulopsis basiglans*	G1		No		2	Yes
A	Freshwater Snails	Small Gland Carico Pyrg	*Pyrgulopsis bifurcata*	G1		No		1	Yes
A	Freshwater Snails	Flat Pyrg	*Pyrgulopsis breviloba*	G1		No		3	Yes
A	Freshwater Snails	Fly Ranch Pyrg	*Pyrgulopsis bruesi*	G1		No		1	Yes
A	Freshwater Snails	Cortez Hills Pebblesnail	*Pyrgulopsis bryantwalkeri*	G1		No		1	No
A	Freshwater Snails	Smooth Glenwood Pyrg	*Pyrgulopsis chamberlini*	G1		Yes		1	No
A	Freshwater Snails	Transverse Gland Pyrg	*Pyrgulopsis cruciglans*	G1		No		4	Yes
A	Freshwater Snails	Desert Springsnail	*Pyrgulopsis deserta*	G2		Yes		4	No
A	Freshwater Snails	Dixie Valley Pyrg	*Pyrgulopsis dixensis*	G1		No		1	Yes
A	Freshwater Snails	Smoke Creek Pyrg	*Pyrgulopsis eremica*	G2		No		5	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Freshwater Snails	Otter Creek Pyrg	*Pyrgulopsis fusca*	G1		Yes		1	No
A	Freshwater Snails	Emigrant Pyrg	*Pyrgulopsis gracilis*	G1		No		2	Yes
A	Freshwater Snails	Hamlin Valley Pyrg	*Pyrgulopsis hamlinensis*	G1		Yes		1	Yes
A	Freshwater Snails	Upper Thousand Spring Pyrg	*Pyrgulopsis hovinghi*	G1		No			Yes
A	Freshwater Snails	Hubbs Pyrg	*Pyrgulopsis hubbsi*	G1		No		2	Yes
A	Freshwater Snails	Humboldt Pyrg	*Pyrgulopsis humboldtensis*	G1		No		4	Yes
A	Freshwater Snails	Kings River Pyrg	*Pyrgulopsis imperialis*	G1		No		2	No
A	Freshwater Snails	Carinate Glenwood Pyrg	*Pyrgulopsis inopinata*	G1		Yes		2	No
A	Freshwater Snails	Landyes Pyrg	*Pyrgulopsis landyei*	G1		No		1	Yes
A	Freshwater Snails	Butterfield Pyrg	*Pyrgulopsis lata*	G1		No		1	Yes
A	Freshwater Snails	Elko Pyrg	*Pyrgulopsis leporina*	G1		No		2	Yes
A	Freshwater Snails	Squat Mud Meadows Pyrg	*Pyrgulopsis limaria*	G1		No		5	Yes
A	Freshwater Snails	Lockes Pyrg	*Pyrgulopsis lockensis*	G1		No		1	Yes
A	Freshwater Snails	Long Valley Pyrg	*Pyrgulopsis longae*	G1		No		1	Yes
A	Freshwater Snails	Western Lahontan Pyrg	*Pyrgulopsis longiglans*	G2		No		13	Yes
A	Freshwater Snails	Hardy Pyrg	*Pyrgulopsis marcida*	G1		No		7	Yes
A	Freshwater Snails	Pahranagat Pebblesnail	*Pyrgulopsis merriami*	G1		No		6	Yes
A	Freshwater Snails	Oasis Valley Springsnail	*Pyrgulopsis micrococcus*	G3		No		4	No
A	Freshwater Snails	Northern Soldier Meadow Pyrg	*Pyrgulopsis militaris*	G1		No		1	Yes
A	Freshwater Snails	Twentyone Mile Pyrg	*Pyrgulopsis millenaria*	G1		No			Yes
A	Freshwater Snails	Camp Valley Pyrg	*Pyrgulopsis montana*	G1		No		1	Yes
A	Freshwater Snails	Neritiform Steptoe Ranch Pyrg	*Pyrgulopsis neritella*	G1		No		1	Yes
A	Freshwater Snails	Ninemile Pyrg	*Pyrgulopsis nonaria*	G1		Yes		2	No
A	Freshwater Snails	Elongate Mud Meadows Pyrg	*Pyrgulopsis notidicola*	G1	C	No		2	Yes
A	Freshwater Snails	Sub-globose Steptoe Ranch Pyrg	*Pyrgulopsis orbiculata*	G1		No		2	Yes
A	Freshwater Snails	Owens Valley Springsnail	*Pyrgulopsis owensensis*	G1		No		11	Yes
A	Freshwater Snails	Big Warm Spring Pyrg	*Pyrgulopsis papillata*	G1		No		2	Yes
A	Freshwater Snails	Bifid Duct Pyrg	*Pyrgulopsis peculiaris*	G2		Yes		8	Yes
A	Freshwater Snails	Antelope Valley Pyrg	*Pyrgulopsis pellita*	G1		No		1	Yes
A	Freshwater Snails	Fish Slough Springsnail	*Pyrgulopsis perturbata*	G1		No		3	Yes
A	Freshwater Snails	Ovate Cain Spring Pyrg	*Pyrgulopsis pictilis*	G1		No		1	Yes
A	Freshwater Snails	Flat-topped Steptoe Pyrg	*Pyrgulopsis planulata*	G1		No		1	Yes
A	Freshwater Snails	Sada's Pyrg	*Pyrgulopsis sadai*	G1		No		6	Yes
A	Freshwater Snails	White River Valley Pyrg	*Pyrgulopsis sathos*	G1		No		6	Yes
A	Freshwater Snails	Sub-globose Snake Pyrg	*Pyrgulopsis saxatilis*	G1		Yes		1	Yes
A	Freshwater Snails	Northern Steptoe Pyrg	*Pyrgulopsis serrata*	G1		No		3	Yes
A	Freshwater Snails	Sterile Basin Pyrg	*Pyrgulopsis sterilis*	G1		No		3	Yes
A	Freshwater Snails	Lake Valley Pyrg	*Pyrgulopsis sublata*	G1		No		1	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Freshwater Snails	Southern Steptoe Pyrg	*Pyrgulopsis sulcata*	G1		No		2	Yes
A	Freshwater Snails	Southern Bonneville Pyrg	*Pyrgulopsis transversa*	G2		Yes		4	Yes
A	Freshwater Snails	Southern Soldier Meadow Pyrg	*Pyrgulopsis umbilicata*	G1		No		5	Yes
A	Freshwater Snails	Northwest Bonneville Pyrg	*Pyrgulopsis variegata*	G2		Yes		10	Yes
A	Freshwater Snails	Duckwater Warm Springs Pyrg	*Pyrgulopsis villacampae*	G1		No		2	Yes
A	Freshwater Snails	Vineyards Pyrg	*Pyrgulopsis vinyardi*	G1		No		2	No
A	Freshwater Snails	Wong's Springsnail	*Pyrgulopsis wongi*	G2		No		49	Yes
A	Freshwater Snails	Fat-whorled Pondsnail	*Stagnicola bonnevillensis*	G1		Yes		5	Yes
A	Freshwater Snails	Mountain Marshsnail	*Stagnicola montanensis*	G3		No		4	No
A	Freshwater Snails	Widelip Pondsnail	*Stagnicola traski*	G3		No		2	No
A	Freshwater Snails	Grated Tryonia	*Tryonia clathrata*	G2		No		3	Yes
A	Freshwater Snails	Grapevine Springs Elongate Tryonia	*Tryonia margae*	G1		No		2	No
A	Freshwater Snails	Monitor Tryonia	*Tryonia monitorae*	G1		No		2	Yes
A	Freshwater Snails	Desert Tryonia	*Tryonia porrecta*	G3		No		9	Yes
A	Freshwater Snails	Grapevine Springs Squat Tryonia	*Tryonia rowlandsi*	G1		No		1	No
A	Freshwater Snails	Desert Valvata	*Valvata utahensis*	G1	LE	Yes		1	No
A	Mammals	Moose	*Alces americanus*	G5		Yes	MA, MI, WA, WI, WY	1	No
A	Mammals	Pallid Bat	*Antrozous pallidus*	G5		Yes	CA, KS, MT, OR, TX, WA, WY	46	Yes
A	Mammals	Sewellel	*Aplodontia rufa*	G5		Yes		1	No
A	Mammals	Sierra Nevada Mountain Beaver	*Aplodontia rufa californica*	T3		Yes	CA, NV	4	No
A	Mammals	Pygmy Rabbit	*Brachylagus idahoensis*	G4		Yes	CA, ID, MT, NV, OR, UT, WA, WY	236	Yes
A	Mammals	Gray Wolf	*Canis lupus*	G4		Yes	CO, ID, IL, ME, MI, MN, MO, MT, ND, NH, NY, UT, VT, WA, WI	2	No
A	Mammals	Townsend's Big-eared Bat	*Corynorhinus townsendii*	G4		Yes	CA, ID, KS, MT, NE, NV, OR, SD, TX, UT, WY	211	Yes
A	Mammals	Utah Prairie Dog	*Cynomys parvidens*	G1	LT	Yes	UT	502	Yes
A	Mammals	Merriam's Kangaroo Rat	*Dipodomys merriami*	G5	PS	No		5	No
A	Mammals	Spotted Bat	*Euderma maculatum*	G4		Yes	AZ, CA, CO, ID, MT, NM, NV, OR, TX, UT, WA, WY	41	Yes
A	Mammals	California Bonneted Bat	*Eumops perotis californicus*	T4		Yes	AZ, TX	6	No
A	Mammals	Northern Flying Squirrel	*Glaucomys sabrinus*	G5		Yes	AK, CT, MD, MI, NV, PA, SD, UT, VT, WA, WI, WY	35	No
A	Mammals	Wolverine	*Gulo gulo*	G4		Yes	AK, CA, CO, ID, UT, WA, WY	37	No
A	Mammals	Allen's Big-eared Bat	*Idionycteris phyllotis*	G3		Yes	CO, NM, NV, UT	2	No
A	Mammals	Western Red Bat	*Lasiurus blossevillii*	G5		Yes	AZ, CA, NM, NV, UT	3	Yes
A	Mammals	Hoary Bat	*Lasiurus cinereus*	G5	PS	No	CA, CT, DE, FL, IN, MA, MD, MI, MS, NC, NH, NJ, NV, NY, OR, PA, RI, VT, WA, WI, WV, WY	19	Yes
A	Mammals	Sierra Nevada Snowshoe Hare	*Lepus americanus tahoensis*	T3		Yes	CA	2	No
A	Mammals	White-tailed Jackrabbit	*Lepus townsendii*	G5		Yes	CO, IA, KS, MO, NE, NM, OR, WA, WI	18	Yes
A	Mammals	North American River Otter	*Lontra canadensis*	G5		Yes	CO, DC, FL, IA, IL, IN, ND, NE, NV, NY, OK, PA, SD, TX, UT, VT, WA, WV, WY	19	No
A	Mammals	Canadian Lynx	*Lynx canadensis*	G5		Yes	CO, ID, ME, MI, MN, MT, NH, NY, UT, VT, WA, WY	2	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Mammals	American Marten	*Martes americana*	G5		Yes	AK, AK, CA, MD, MI, NH, NM, NV, NY, OR, UT, VT, WA, WA, WI, WY	6	No
A	Mammals	Fisher - West Coast Distinct Population Segment	*Martes pennanti pop. 1*	T2	C	No	WA	7	No
A	Mammals	Dark Kangaroo Mouse	*Microdipodops megacephalus*	G4		Yes	NV, UT	27	Yes
A	Mammals	Desert Valley Kangaroo Mouse	*Microdipodops megacephalus albiventer*	T2		Yes	NV	4	Yes
A	Mammals	Fletcher Kangaroo Mouse	*Microdipodops megacephalus nasutus*	T2		Yes		2	Yes
A	Mammals	Pale Kangaroo Mouse	*Microdipodops pallidus*	G3		Yes	NV		Yes
A	Mammals	Pahranagat Valley Vole	*Microtus montanus fucosus*	T2		Yes	NV	6	No
A	Mammals	Fringed Myotis	*Myotis thysanodes*	G4		Yes	CA, CO, ID, NE, NV, OR, TX, UT, WA, WY	28	Yes
A	Mammals	Big Free-tailed Bat	*Nyctinomops macrotis*	G5		Yes	AZ, CA, NV, TX, UT	8	No
A	Mammals	American Pika	*Ochotona princeps*	G5		Yes	NV, UT, WA	29	No
A	Mammals	Desert Bighorn Sheep	*Ovis canadensis nelsoni*	T4		Yes	CA, CA, NV	5	Yes
A	Mammals	Sierra Nevada Bighorn Sheep	*Ovis canadensis sierrae*	T1	LE	Yes	CA, NV	4	Yes
A	Mammals		*Sciurus griseus griseus*	T5		Yes		2	No
A	Mammals	Mt. Lyell Shrew	*Sorex lyelli*	G2		No	CA	9	No
A	Mammals	Preble's Shrew	*Sorex preblei*	G4		Yes	CO, NM, NV, UT, WA, WY	4	Yes
A	Mammals	Mohave Ground Squirrel	*Spermophilus mohavensis*	G2		Yes	CA	5	No
A	Mammals	Brazilian Free-tailed Bat	*Tadarida brasiliensis*	G5		Yes	AL, AZ, OK, TX	43	Yes
A	Mammals	American Black Bear	*Ursus americanus*	G5		Yes	AL, AR, CT, KS, KY, MA, MO, MS, NM, RI, SC, TX, VT, WA	2	Yes
A	Mammals	Brown Bear	*Ursus arctos*	G4		Yes	AK, CO, ID, MT, UT, WA, WY	7	No
A	Mammals	Kit Fox	*Vulpes macrotis*	G4		Yes	CO, NV, OR, UT	308	No
A	Mammals	Red Fox	*Vulpes vulpes*	G5		Yes	AZ, WA	4	No
A	Mammals	Sierra Nevada Red Fox	*Vulpes vulpes necator*	T2		Yes	CA, NV	7	No
A	Mayflies	A Mayfly	*Ameletus edmundsi*	G1		No		2	No
A	Mayflies	A Mayfly	*Cinygmula gartrelli*	G2		No		1	No
A	Mayflies	A Mayfly	*Paraleptophlebia packii*	G2		No		2	No
A	Mayflies	A Mayfly	*Parameletus columbiae*	G2		No		1	No
A	Mayflies	A Mayfly	*Susperatus tuberculatus*	G1		No		1	No
A	Millipedes and Centipedes	A Millipede	*Polydesmus cavicola*	G1		No		1	No
A	Other Beetles	Crescent-dune Aegialian Scarab Beetle	*Aegialia crescenta*	G1		No		1	Yes
A	Other Beetles	Hardy's Aegialian Scarab Beetle	*Aegialia hardyi*	G1		No		2	Yes
A	Other Beetles	Utah Chaetarthrian Water Scavenger Beetle	*Chaetarthria utahensis*	G1		No		1	No
A	Other Beetles	A Beetle	*Coenonycha pygmaea*	G1		No		2	Yes
A	Other Beetles	Leech's Skyline Diving Beetle	*Hydroporus leechi*	G1		No		1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Other Beetles	Travertine Band-thigh Diving Beetle	*Hygrotus fontinalis*	G1		No		4	Yes
A	Other Beetles	Nelson's Miloderes Weevil	*Miloderes nelsoni*	G2		No		1	No
A	Other Beetles	Saline Valley Snow-front Scarab Beetle	*Polyphylla anteronivea*	G1		No		1	No
A	Other Beetles	Spotted Warner Valley Dunes Scarab Beetle	*Polyphylla avittata*	G2		No		2	No
A	Other Beetles	Crescent Dune Serican Scarab Beetle	*Serica ammomenisco*	G1		No		1	Yes
A	Other Beetles	Humboldt Serican Beetle	*Serica humboldti*	G1		No		1	Yes
A	Other Beetles	Sand Mountain Serican Scarab Beetle	*Serica psammobunus*	G1		No		2	Yes
A	Other Beetles		*Stenelmis lariversi*	G1		No		1	No
A	Other Beetles	Moapa Warm Springs Riffle Beetle	*Stenelmis moapa*	G1		No		1	No
A	Other Insects	Amargosa Naucorid Bug	*Pelocoris shoshone*	G2		No		1	No
A	Reptiles	Zebra-tailed Lizard	*Callisaurus draconoides*	G5		Yes	UT	60	No
A	Reptiles	Western Banded Gecko	*Coleonyx variegatus*	G5		Yes	NV, UT	29	No
A	Reptiles	Sidewinder	*Crotalus cerastes*	G5		Yes	UT	17	No
A	Reptiles	Speckled Rattlesnake	*Crotalus mitchellii*	G5		Yes	UT	2	No
A	Reptiles	Mohave Rattlesnake	*Crotalus scutulatus*	G5		Yes	UT	12	No
A	Reptiles	Desert Iguana	*Dipsosaurus dorsalis*	G5		Yes	NV, UT	1	No
A	Reptiles	Sierra Alligator Lizard	*Elgaria coerulea palmeri*	T4		Yes	NV	2	No
A	Reptiles	Panamint Alligator Lizard	*Elgaria panamintina*	G2		No	CA	8	Yes
A	Reptiles	Gila Monster	*Heloderma suspectum*	G4		Yes	NM, UT	40	No
A	Reptiles	Banded Gila Monster	*Heloderma suspectum cinctum*	T4		Yes	CA, NV	6	No
A	Reptiles	Sonoran Mountain Kingsnake	*Lampropeltis pyromelana*	G4		Yes	NM, NV, UT	37	No
A	Reptiles	Western Threadsnake	*Leptotyphlops humilis*	G5		Yes	UT	5	No
A	Reptiles	Smooth Greensnake	*Opheodrys vernalis*	G5		Yes	CT, IA, IL, IN, MI, MN, MO, MT, NC, ND, NE, NH, NY, PA, UT, VA, VT, WY	9	No
A	Reptiles	Common Chuckwalla	*Sauromalus ater*	G5		Yes	CA, NV, UT	54	No
A	Reptiles	Common Gartersnake	*Thamnophis sirtalis*	G5	PS	No	CO, DC, NM, OH, UT, WY	45	No
A	Reptiles	Desert Night Lizard	*Xantusia vigilis*	G5		Yes	AZ, UT	10	No
A	Spiders and other Chelicerates	A Cave Obligate Harvestman	*Hesperonemastoma packardi*	G1		No		1	No
A	Stoneflies	A Stonefly	*Capnia hornigi*	G3		No			Yes
A	Stoneflies	A Stonefly	*Capnia mono*	G2		No			Yes
A	Stoneflies	Tiny Forestfly	*Malenka tina*	G3		No		1	No
A	Stoneflies	Utah Needlefly	*Perlomyia utahensis*	G3		No		16	No
A	Stoneflies	Utah Sallfly	*Sweltsa gaufini*	G3		No		4	No
A	Terrestrial Snails	Sierra Ambersnail	*Catinella stretchiana*	G3		No		1	No
A	Terrestrial Snails	Cross Snaggletooth	*Gastrocopta quadridens*	G2		No		1	No
A	Terrestrial Snails	Southern Tightcoil	*Ogaridiscus subrupicola*	G1		Yes		1	No
A	Terrestrial Snails	Eureka Mountainsnail	*Oreohelix eurekensis*	G1		Yes		3	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Terrestrial Snails	Lyrate Mountainsnail	*Oreohelix haydeni*	G2		Yes		19	Yes
A	Terrestrial Snails	Whitepine Mountainsnail	*Oreohelix hemphilli*	G2		No			Yes
A	Terrestrial Snails	Mill Creek Mountainsnail	*Oreohelix howardi*	G1		No		3	No
A	Terrestrial Snails	Goshute Mountainsnail	*Oreohelix loisae*	G2		No		3	No
A	Terrestrial Snails	Schell Creek Mountainsnail	*Oreohelix nevadensis*	G1		No		5	Yes
A	Terrestrial Snails	Brian Head Mountainsnail	*Oreohelix parawanensis*	G1		Yes		4	No
A	Terrestrial Snails	Deseret Mountainsnail	*Oreohelix peripherica*	G2		Yes		11	No
A	Terrestrial Snails	Ogden Rocky Mountainsnail	*Oreohelix peripherica wasatchensis*	T1		Yes		1	No
A	Terrestrial Snails	Rustic Ambersnail	*Succinea rusticana*	G2		No		3	No
A	Tiger Beetles	Mojave Giant Tiger Beetle	*Amblycheila schwarzi*	G3		No		1	No
A	Tiger Beetles	Riparian Tiger Beetle	*Cicindela praetextata*	G2		No		1	No
A	Turtles	Desert Tortoise	*Gopherus agassizii*	G4	LT, SAT	Yes	AZ, AZ, CA, NV, UT	632	No
P	Conifers and relatives	Washoe Pine	*Pinus washoensis*	G3		Yes		5	No
P	Ferns and relatives	Upward-lobed Moonwort	*Botrychium ascendens*	G2		No		4	No
P	Ferns and relatives	Crenulate Moonwort	*Botrychium crenulatum*	G3		No		15	No
P	Ferns and relatives	Narrowleaf Grapefern	*Botrychium lineare*	G2		No		1	No
P	Ferns and relatives	Utah Spike-moss	*Selaginella utahensis*	G2		No		5	No
P	Flowering Plants	Passey's Onion	*Allium passeyi*	G1		No		12	Yes
P	Flowering Plants	Wheeler's Angelica	*Angelica wheeleri*	G2		No		11	No
P	Flowering Plants	Meadow Pussytoes	*Antennaria arcuata*	G2		No		4	No
P	Flowering Plants	Beckwith's Rockcress	*Arabis beckwithii*	G2		No		3	No
P	Flowering Plants	Bodie Hills Rockcress	*Arabis bodiensis*	G2		No		29	Yes
P	Flowering Plants	Unequal Rockcress	*Arabis dispar*	G3		No		20	Yes
P	Flowering Plants	Grouse Creek Rockcress	*Arabis falcatoria*	G1		No		10	Yes
P	Flowering Plants	Elko Rockcress	*Arabis falcifructa*	G1		No		1	Yes
P	Flowering Plants	Wasatch Range Rockcress	*Arabis lasiocarpa*	G3		No		19	No
P	Flowering Plants	Ophir Rockcress	*Arabis ophira*	G1		No		15	Yes
P	Flowering Plants	Pinzl's Rockcress	*Arabis pinzliae*	G2		No		11	Yes
P	Flowering Plants	Shockley's Rockcress	*Arabis shockleyi*	G3		No		30	No
P	Flowering Plants	Tiehm's Rockcress	*Arabis tiehmii*	G2		No		14	No
P	Flowering Plants	Dwarf Bear-poppy	*Arctomecon humilis*	G1	LE	No		170	No
P	Flowering Plants	White Bear-poppy	*Arctomecon merriamii*	G3		No		9	No
P	Flowering Plants	Packard's Wormwood	*Artemisia packardiae*	G3		No		3	No
P	Flowering Plants	Eastwood's Milkweed	*Asclepias eastwoodiana*	G2		No		32	Yes
P	Flowering Plants	Ackerman's Milkvetch	*Astragalus ackermanii*	G2		No		3	No
P	Flowering Plants		*Astragalus ampullarioides*	G1	LE	No		5	No
P	Flowering Plants		*Astragalus avonensis*	G1		No		1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Beatley's Milkvetch	*Astragalus beatleyae*	G2		No		40	Yes
P	Flowering Plants	Callaway Milkvetch	*Astragalus callithrix*	G3		No		20	Yes
P	Flowering Plants	Ground-crescent Milkvetch	*Astragalus chamaemeniscus*	G2		No		2	No
P	Flowering Plants	Mesic Milkvetch	*Astragalus diversifolius*	G2		No		3	Yes
P	Flowering Plants	Peck Station Milkvetch	*Astragalus eurylobus*	G2		No		6	Yes
P	Flowering Plants	Black Milkvetch	*Astragalus funereus*	G2		No		8	No
P	Flowering Plants	Gilman's Milkvetch	*Astragalus gilmanii*	G2		No		3	Yes
P	Flowering Plants	Holmgren's Milkvetch	*Astragalus holmgreniorum*	G1	LE	Yes		4	No
P	Flowering Plants	Inyo Milkvetch	*Astragalus inyoensis*	G3		No		1	No
P	Flowering Plants	Long Valley Milkvetch	*Astragalus johannis-howellii*	G2		Yes		28	Yes
P	Flowering Plants	Lemmon's Milkvetch	*Astragalus lemmonii*	G2		No		8	No
P	Flowering Plants	Lens-pod Milkvetch	*Astragalus lentiformis*	G2		No		23	No
P	Flowering Plants	Fish Slough Milkvetch	*Astragalus lentiginosus var. piscinensis*	T1	LT	No		8	Yes
P	Flowering Plants	Sodaville Milkvetch	*Astragalus lentiginosus var. sesquimetralis*	T1		Yes		3	Yes
P	Flowering Plants	Heliotrope Milkvetch	*Astragalus limnocharis var. montii*	T1	LT	No		11	No
P	Flowering Plants	Glenwood Milkvetch	*Astragalus loanus*	G1		No		7	No
P	Flowering Plants	Mono Milkvetch	*Astragalus monoensis*	G2		Yes		37	Yes
P	Flowering Plants	Nye Milkvetch	*Astragalus nyensis*	G3		No		2	No
P	Flowering Plants	Rydberg's Milkvetch	*Astragalus perianus*	G3		No		1	No
P	Flowering Plants	Pinyon Milkvetch	*Astragalus pinonis*	G2		No		3	Yes
P	Flowering Plants	Tonopah Milkvetch	*Astragalus pseudiodanthus*	G2		No		24	Yes
P	Flowering Plants	Winged Milkvetch	*Astragalus pterocarpus*	G3		No		19	Yes
P	Flowering Plants	Raven's Milkvetch	*Astragalus ravenii*	G1		No		3	Yes
P	Flowering Plants	Weak Milkvetch	*Astragalus solitarius*	G3		No		3	No
P	Flowering Plants	Silver Reef Milkvetch	*Astragalus straturensis*	G2		No		25	Yes
P	Flowering Plants	Toquima Milkvetch	*Astragalus toquimanus*	G2		No		11	Yes
P	Flowering Plants	Currant Milkvetch	*Astragalus uncialis*	G2		No		79	Yes
P	Flowering Plants	Welsh's Milkvetch	*Astragalus welshii*	G2		No		1	No
P	Flowering Plants	Mud-flat Milkvetch	*Astragalus yoder-williamsii*	G3		Yes		1	No
P	Flowering Plants	Bonneville Saltbush	*Atriplex bonnevillensis*	G2		No			Yes
P	Flowering Plants	Last Chance Rock Cress	*Boechera yorkii*	G1		No		2	No
P	Flowering Plants	Inyo County Mariposa-lily	*Calochortus excavatus*	G3		No		61	Yes
P	Flowering Plants	Panamint Mountain Mariposa Lily	*Calochortus panamintensis*	G3		No		1	No
P	Flowering Plants	Baird's Camissonia	*Camissonia bairdii*	G1		No		1	No
P	Flowering Plants	Diamond Valley Suncup	*Camissonia gouldii*	G1		No		2	Yes
P	Flowering Plants	Nevada Evening-primrose	*Camissonia nevadensis*	G3		No		11	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Tioga Pass Sedge	*Carex tiogana*	G1		No		4	No
P	Flowering Plants	Tushar Paintbrush	*Castilleja parvula*	G2		No		9	No
P	Flowering Plants	Reveal's Indian-paintbrush	*Castilleja revealii*	G2		No		2	No
P	Flowering Plants	Monte Neva Paintbrush	*Castilleja salsuginosa*	G1		Yes		2	Yes
P	Flowering Plants	Barneby's Caulanthus	*Caulanthus barnebyi*	G2		No		11	Yes
P	Flowering Plants	Jaeger's Caulostramina	*Caulostramina jaegeri*	G1		No		13	No
P	Flowering Plants	Pintwater Rabbitbrush	*Chrysothamnus eremobius*	G1		No		1	No
P	Flowering Plants	Ownbey's Thistle	*Cirsium ownbeyi*	G3		No		1	No
P	Flowering Plants	Virgin Thistle	*Cirsium virginense*	G2		Yes		4	No
P	Flowering Plants	Pygmy Pussy-paws	*Cistanthe pygmaea*	G2		No		3	No
P	Flowering Plants	Barren Valley Collomia	*Collomia renacta*	G1		No		2	Yes
P	Flowering Plants	Tecopa Bird's-beak	*Cordylanthus tecopensis*	G2		No		2	Yes
P	Flowering Plants	Compact Cat's-eye	*Cryptantha compacta*	G2		No		11	Yes
P	Flowering Plants	Subalpine Cryptantha	*Cryptantha crymophila*	G2		No		5	No
P	Flowering Plants	Yellow-white Catseye	*Cryptantha ochroleuca*	G1		No		1	No
P	Flowering Plants	Bristle-cone Cryptantha	*Cryptantha roosiorum*	G1		Yes		24	No
P	Flowering Plants	Welsch's Cat's-eye	*Cryptantha welshii*	G3		No		42	Yes
P	Flowering Plants	Bodie Hills Cusickiella	*Cusickiella quadricostata*	G2		No		54	Yes
P	Flowering Plants	Intermountain Wavewing	*Cymopterus basalticus*	G2		No		19	Yes
P	Flowering Plants	Gray Wavewing	*Cymopterus cinerarius*	G2		No		3	No
P	Flowering Plants	Coulter's Biscuitroot	*Cymopterus coulteri*	G3		No		27	Yes
P	Flowering Plants	Toiyabe Spring-parsley	*Cymopterus goodrichii*	G1		No		7	Yes
P	Flowering Plants	Jone's Wavewing	*Cymopterus jonesii*	G2		No		15	Yes
P	Flowering Plants	Cedar Breaks Biscuitroot	*Cymopterus minimus*	G1		No		15	No
P	Flowering Plants	Large Yellow Lady's-slipper	*Cypripedium parviflorum var. pubescens*	T5		Yes		4	No
P	Flowering Plants	July Gold	*Dedeckera eurekensis*	G2		Yes		50	Yes
P	Flowering Plants	Desert Whitlow-grass	*Draba arida*	G2		No		19	Yes
P	Flowering Plants	Wasatch Draba	*Draba brachystylis*	G1		No		8	No
P	Flowering Plants	White Mountain Draba	*Draba californica*	G3		No		1	Yes
P	Flowering Plants	Rockcress Draba	*Draba globosa*	G3		No		5	No
P	Flowering Plants	Sweetwater Mountains Draba	*Draba incrassata*	G3		No		17	No
P	Flowering Plants	Kass's Rockcress	*Draba kassii*	G1		No		5	Yes
P	Flowering Plants	Maguire's Whitlow-grass	*Draba maguirei*	G3		No		15	No
P	Flowering Plants	White Mountains draba	*Draba monoensis*	G1		No		3	Yes
P	Flowering Plants	Pennell's Draba	*Draba pennellii*	G2		No		12	Yes
P	Flowering Plants	Tushar Mountain Whitlow-grass	*Draba ramulosa*	G1		No		5	No
P	Flowering Plants	Mt. Whitney Draba	*Draba sharsmithii*	G1		No		4	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Sierra Nevada Draba	*Draba sierrae*	G2		No		12	No
P	Flowering Plants	Stolon Whitlow-grass	*Draba sobolifera*	G2		No		9	No
P	Flowering Plants	Mountain Whitlow-grass	*Draba sphaeroides*	G2		No		10	Yes
P	Flowering Plants	White Mountain Draba	*Draba subumbellata*	G3		No		2	Yes
P	Flowering Plants	Engelmann's Hedgehog Cactus	*Echinocereus engelmannii var. armatus*	T2		Yes		2	No
P	Flowering Plants	Nevada Willowherb	*Epilobium nevadense*	G2		No		16	Yes
P	Flowering Plants	Pine Valley Goldenbush	*Ericameria crispa*	G2		No		4	Yes
P	Flowering Plants	Gilman Goldenweed	*Ericameria gilmanii*	G1		No		1	No
P	Flowering Plants	Greenwood's Heath-goldenrod	*Ericameria lignumviridis*	G1		No		1	No
P	Flowering Plants	Cedar Breaks Goldenbush	*Ericameria zionis*	G2		No		1	No
P	Flowering Plants	Bald Daisy	*Erigeron calvus*	G1		No		1	No
P	Flowering Plants	Carrington's Daisy	*Erigeron carringtoniae*	G1		No		1	No
P	Flowering Plants	Cave Mountain Fleabane	*Erigeron cavernensis*	G2		No		4	No
P	Flowering Plants	Mound Daisy	*Erigeron compactus*	G2		No		35	No
P	Flowering Plants	Cronquist's Daisy	*Erigeron cronquistii*	G2		No		12	No
P	Flowering Plants	Garrett's Daisy	*Erigeron garrettii*	G2		No		20	No
P	Flowering Plants	Broad Fleabane	*Erigeron latus*	G3		No		5	No
P	Flowering Plants	Starved Daisy	*Erigeron miser*	G2		No		1	No
P	Flowering Plants	Sheep Fleabane	*Erigeron ovinus*	G2		No		7	Yes
P	Flowering Plants	Professor Daisy	*Erigeron proselyticus*	G2		No		9	No
P	Flowering Plants	Ibex Buckwheat	*Eriogonum ammophilum*	G1		No		18	Yes
P	Flowering Plants	Mono Buckwheat	*Eriogonum ampullaceum*	G3		No		3	Yes
P	Flowering Plants	Wind-loving Buckwheat	*Eriogonum anemophilum*	G2		No		35	Yes
P	Flowering Plants	Ruby Valley Buckwheat	*Eriogonum argophyllum*	G1		Yes		1	Yes
P	Flowering Plants	Beatley's Buckwheat	*Eriogonum beatleyae*	G2		No		40	Yes
P	Flowering Plants	Darin Buckwheat	*Eriogonum concinnum*	G2		No		16	No
P	Flowering Plants	Reveal's Buckwheat	*Eriogonum contiguum*	G2		No		1	No
P	Flowering Plants	Crosby's Buckwheat	*Eriogonum crosbyae*	G3		No		2	No
P	Flowering Plants	Darrow's Buckwheat	*Eriogonum darrovii*	G2		No		8	Yes
P	Flowering Plants	Churchill Narrows Buckwheat	*Eriogonum diatomaceum*	G1	C	Yes		31	No
P	Flowering Plants	Wildrose Canyon Buckwheat	*Eriogonum eremicola*	G1		No		2	No
P	Flowering Plants	Limestone Buckwheat	*Eriogonum eremicum*	G2		No		18	Yes
P	Flowering Plants	Gilman's Buckwheat	*Eriogonum gilmanii*	G2		No		5	No
P	Flowering Plants	Holmgren's Buckwheat	*Eriogonum holmgrenii*	G1		No		4	Yes
P	Flowering Plants	Lewis' Buckwheat	*Eriogonum lewisii*	G2		No		30	No
P	Flowering Plants	Logan Buckwheat	*Eriogonum loganum*	G2		No		9	No
P	Flowering Plants	Lost Creek Buckwheat	*Eriogonum mitophyllum*	G1		No		4	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Son's Buckwheat	*Eriogonum natum*	G2		No		10	Yes
P	Flowering Plants	Steamboat Buckwheat	*Eriogonum ovalifolium var. williamsiae*	T1	LE	Yes		2	Yes
P	Flowering Plants	A Buckwheat	*Eriogonum phoeniceum*	G1		No		3	Yes
P	Flowering Plants	Prostrate Buckwheat	*Eriogonum prociduum*	G3		No		1	No
P	Flowering Plants	Altered Andesite Buckwheat	*Eriogonum robustum*	G2		No		156	Yes
P	Flowering Plants	Lahontan Basin Buckwheat	*Eriogonum rubricaule*	G3		No		6	Yes
P	Flowering Plants	Frisco Buckwheat	*Eriogonum soredium*	G1		No		17	Yes
P	Flowering Plants	Tiehm's Buckwheat	*Eriogonum tiehmii*	G1		No		6	Yes
P	Flowering Plants	Viviparous Foxtail Cactus	*Escobaria vivipara var. rosea*	T3		Yes		54	No
P	Flowering Plants	Sunnyside Green-gentian	*Frasera gypsicola*	G1		Yes		29	Yes
P	Flowering Plants	Nye Gilia	*Gilia nyensis*	G3		No		32	No
P	Flowering Plants	Ripley's Gilia	*Gilia ripleyi*	G3		No		6	No
P	Flowering Plants	Goldenrod Snakeweed	*Gutierrezia petradoria*	G3		No		19	Yes
P	Flowering Plants	Poison Canyon Stickseed	*Hackelia brevicula*	G2		No		8	Yes
P	Flowering Plants	Deep Creek Stickseed	*Hackelia ibapensis*	G1		No		2	Yes
P	Flowering Plants	Three Forks Stickseed	*Hackelia ophiobia*	G3		No		1	No
P	Flowering Plants	Sharsmith's Stickseed	*Hackelia sharsmithii*	G3		No		18	No
P	Flowering Plants	Utah Sunflower	*Helianthus deserticola*	G2		No		16	Yes
P	Flowering Plants	White Mountains Horkelia	*Horkelia hispidula*	G2		No		21	Yes
P	Flowering Plants	Sanderson's Cheesebush	*Hymenoclea sandersonii*	G1		No		1	No
P	Flowering Plants	California Satintail	*Imperata brevifolia*	G2		No		1	No
P	Flowering Plants	Field Ivesia	*Ivesia campestris*	G3		No		1	No
P	Flowering Plants	King's Ivesia	*Ivesia kingii*	G3	PS	No		2	No
P	Flowering Plants	Pine Nut Ivesia	*Ivesia pityocharis*	G2		No		14	Yes
P	Flowering Plants	Plumas Ivesia	*Ivesia sericoleuca*	G2		No		68	No
P	Flowering Plants	Utah Ivesia	*Ivesia utahensis*	G2		No		4	No
P	Flowering Plants	Webber Ivesia	*Ivesia webberi*	G2	C	Yes		27	Yes
P	Flowering Plants	Waxflower	*Jamesia tetrapetala*	G2		No		12	Yes
P	Flowering Plants	Grime's Vetchling	*Lathyrus grimesii*	G2		No		3	No
P	Flowering Plants	Bullfrog Hills Sweetpea	*Lathyrus hitchcockianus*	G2		No		13	No
P	Flowering Plants	Southwestern Pepper-grass	*Lepidium nanum*	G3		No		4	Yes
P	Flowering Plants	Ostler's Pepper-grass	*Lepidium ostleri*	G1		No		4	Yes
P	Flowering Plants	Owyhee Prickly-phlox	*Leptodactylon glabrum*	G2		No		3	Yes
P	Flowering Plants	Garrett's Bladderpod	*Lesquerella garrettii*	G2		No		58	No
P	Flowering Plants	Tunnel Springs Mountain Bladderpod	*Lesquerella goodrichii*	G2		No		2	Yes
P	Flowering Plants	Hitchcock's Bladderpod	*Lesquerella hitchcockii*	G3		No			Yes
P	Flowering Plants	Snake Range Bladderpod	*Lesquerella pendula*	G2		No			Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Bryce Bladderpod	*Lesquerella rubicundula*	G3	PS	No		1	No
P	Flowering Plants	Utah Bladderpod	*Lesquerella utahensis*	G3		No		1	No
P	Flowering Plants	Maguire's Bitteroot	*Lewisia maguirei*	G1		No		8	Yes
P	Flowering Plants	Packard's Desert-parsley	*Lomatium packardiae*	G2		No		2	No
P	Flowering Plants	Rose-flower Desert-parsley	*Lomatium roseanum*	G2		No		4	No
P	Flowering Plants	Mono Lake Lupine	*Lupinus duranii*	G2		No		45	Yes
P	Flowering Plants	Slender Lupine	*Lupinus gracilentus*	G3		No		2	No
P	Flowering Plants	Holmgren Lupine	*Lupinus holmgrenianus*	G2		No		5	No
P	Flowering Plants	Father Crowley's Lupine	*Lupinus padre-crowleyi*	G2		Yes		18	No
P	Flowering Plants	Pioche Blazingstar	*Mentzelia argillicola*	G1		No		5	No
P	Flowering Plants	Arapien Stickleaf	*Mentzelia argillosa*	G2		No		81	No
P	Flowering Plants	Inyo balzingstar	*Mentzelia inyoensis*	G2		No		6	No
P	Flowering Plants	Smooth Stickleaf	*Mentzelia mollis*	G2		No		3	Yes
P	Flowering Plants		*Mentzelia tiehmii*	G1		No		7	No
P	Flowering Plants	Three-tooth Blazingstar	*Mentzelia tridentata*	G2		No		1	No
P	Flowering Plants	Eggleaf Monkeyflower	*Mimulus ovatus*	G1		No		9	Yes
P	Flowering Plants	Bashful Four-o'clock	*Mirabilis pudica*	G3		No		1	No
P	Flowering Plants	sweet-smelling monardella	*Monardella beneolens*	G1		No		5	No
P	Flowering Plants	Rydberg's Musineon	*Musineon lineare*	G2		No		24	No
P	Flowering Plants	Eureka Dunes Evening-primrose	*Oenothera californica ssp. eurekensis*	T1	LE	Yes		3	No
P	Flowering Plants	Sand Cholla	*Opuntia pulchella*	G4		Yes		54	Yes
P	Flowering Plants	Plumas Mountaincrown	*Oreostemma elatum*	G2		No		1	No
P	Flowering Plants	Nevada Oryctes	*Oryctes nevadensis*	G2		No		111	Yes
P	Flowering Plants	Beaver Mountain Groundsel	*Packera castoreus*	G1		No		2	No
P	Flowering Plants	Podunk Groundsel	*Packera malmstenii*	G1		No		1	No
P	Flowering Plants	Ligulate Feverfew	*Parthenium ligulatum*	G3		No		1	No
P	Flowering Plants	Siler Pincushion Cactus	*Pediocactus sileri*	G3	LT	Yes		2	No
P	Flowering Plants	Simpson's Hedgehog Cactus	*Pediocactus simpsonii*	G4		Yes		7	No
P	Flowering Plants	Firleaf Beardtongue	*Penstemon abietinus*	G2		No		12	No
P	Flowering Plants	Dune Beardtongue	*Penstemon arenarius*	G2		No		32	Yes
P	Flowering Plants	Red Canyon Beardtongue	*Penstemon bracteatus*	G2		No		2	No
P	Flowering Plants	Limestone Beardtongue	*Penstemon calcareus*	G2		No		8	No
P	Flowering Plants	Bear River Range Beardtongue	*Penstemon compactus*	G2		No		19	No
P	Flowering Plants	Tunnel Springs Beardtongue	*Penstemon concinnus*	G3		No		22	Yes
P	Flowering Plants	Cordelia's Penstemon	*Penstemon floribundus*	G1		No		8	Yes
P	Flowering Plants	Ben Franklin's Beardtongue	*Penstemon franklinii*	G1		No		7	Yes
P	Flowering Plants	Mt. Moriah Beardtongue	*Penstemon moriahensis*	G1		No		8	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Low Beardtongue	*Penstemon nanus*	G3		No		31	Yes
P	Flowering Plants	Pahute Mesa Beardtongue	*Penstemon pahutensis*	G3		No		48	Yes
P	Flowering Plants	Petiolate Beardtongue	*Penstemon petiolatus*	G2		No		9	No
P	Flowering Plants	Pinyon Penstemon	*Penstemon pinorum*	G1		No		36	Yes
P	Flowering Plants	Broadleaf Beardtongue	*Penstemon platyphyllus*	G2		No		35	Yes
P	Flowering Plants	Kawich Range Beardtongue	*Penstemon pudicus*	G1		No		6	Yes
P	Flowering Plants	Rhizome Beardtongue	*Penstemon rhizomatosus*	G1		No		6	Yes
P	Flowering Plants	Wassuk Beardtongue	*Penstemon rubicundus*	G2		No		22	Yes
P	Flowering Plants	Susanville Beardtongue	*Penstemon sudans*	G3		No		5	No
P	Flowering Plants	Tidestrom Beardtongue	*Penstemon tidestromii*	G2		No		14	Yes
P	Flowering Plants	Shoshone Beardtongue	*Penstemon tiehmii*	G1		No		3	Yes
P	Flowering Plants	Tushar Range Beardtongue	*Penstemon tusharensis*	G2		No		4	No
P	Flowering Plants	Ward Beardtongue	*Penstemon wardii*	G2		No		33	No
P	Flowering Plants	Inyo Rock Daisy	*Perityle inyoensis*	G2		No		6	No
P	Flowering Plants	Hanaupah rock daisy	*Perityle villosa*	G1		No		2	No
P	Flowering Plants	marble rockmat	*Petrophyton acuminatum*	G1		No		1	No
P	Flowering Plants	Aven Nelson's Phacelia	*Phacelia anelsonii*	G2		No		7	No
P	Flowering Plants	Beatley's Phacelia	*Phacelia beatleyae*	G3		No		13	No
P	Flowering Plants		*Phacelia filiae*	G2		No		4	No
P	Flowering Plants	Inconspicuous Scorpionweed	*Phacelia inconspicua*	G2		Yes		4	Yes
P	Flowering Plants	Playa Phacelia	*Phacelia inundata*	G2		No		3	No
P	Flowering Plants	Inyo Phacelia	*Phacelia inyoensis*	G3		No		23	No
P	Flowering Plants	Tiny-flower Phacelia	*Phacelia minutissima*	G3		No		30	Yes
P	Flowering Plants	Mono County Phacelia	*Phacelia monoensis*	G3		No		43	Yes
P	Flowering Plants	Death Valley Roundleaf Phacelia	*Phacelia mustelina*	G2		No		9	No
P	Flowering Plants	Parish's Phacelia	*Phacelia parishii*	G2		No		9	Yes
P	Flowering Plants	Utah Phacelia	*Phacelia utahensis*	G2		No		190	No
P	Flowering Plants	Repand Twinpod	*Physaria repanda*	G1		No		1	No
P	Flowering Plants	Clustered Popcorn-flower	*Plagiobothrys glomeratus*	G2		No		11	Yes
P	Flowering Plants	Parish's Popcorn-flower	*Plagiobothrys parishii*	G1		No		6	No
P	Flowering Plants	Desert Allocarya	*Plagiobothrys salsus*	G2		No		1	No
P	Flowering Plants	Mason's Skypilot	*Polemonium chartaceum*	G1		No		14	Yes
P	Flowering Plants	Washoe Combleaf	*Polyctenium williamsiae*	G2		Yes		35	Yes
P	Flowering Plants	Spiny Milkwort	*Polygala heterorhyncha*	G3		No		5	Yes
P	Flowering Plants	Pygmy Poreleaf	*Porophyllum pygmaeum*	G2		No		1	No
P	Flowering Plants	Soldier Meadows Cinquefoil	*Potentilla basaltica*	G1	C	No		9	Yes
P	Flowering Plants	Cottam's Potentilla	*Potentilla cottamii*	G1		No		6	Yes
P	Flowering Plants	Morefield's Cinquefoil	*Potentilla morefieldii*	G1		No		17	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Ruby Mountains Primrose	*Primula capillaris*	G1		No		8	Yes
P	Flowering Plants	House Range Primrose	*Primula domensis*	G1		No		5	Yes
P	Flowering Plants	Maguire's Primrose	*Primula maguirei*	G1	LT	No		14	No
P	Flowering Plants	Nevada Primrose	*Primula nevadensis*	G2		No		10	Yes
P	Flowering Plants	King's Indigo-bush	*Psorothamnus kingii*	G3		No		10	Yes
P	Flowering Plants	Sticky Haplopappus	*Pyrrocoma lucida*	G3		No		83	No
P	Flowering Plants	Blaine's Pincushion	*Sclerocactus blainei*	G1		Yes		4	Yes
P	Flowering Plants	Nye County Fish-hook Cactus	*Sclerocactus nyensis*	G1		Yes		3	Yes
P	Flowering Plants	Mohave Fishhook Cactus	*Sclerocactus polyancistrus*	G4		Yes		23	No
P	Flowering Plants	Great Basin Fishhook Cactus	*Sclerocactus pubispinus*	G4		Yes		36	No
P	Flowering Plants	Schlesser's Pincushion	*Sclerocactus schlesseri*	G1		Yes		13	Yes
P	Flowering Plants	Desert Valley Fishhook Cactus	*Sclerocactus spinosior*	G2		No		18	Yes
P	Flowering Plants	Musinea Ragwort	*Senecio musiniensis*	G1		No		3	No
P	Flowering Plants	Mono Ragwort	*Senecio pattersonensis*	G2		No		12	No
P	Flowering Plants	Owens Valley Checker-mallow	*Sidalcea covillei*	G3		Yes		52	Yes
P	Flowering Plants	Jan's Catchfly	*Silene nachlingerae*	G2		No		19	Yes
P	Flowering Plants	Peterson's Catchfly	*Silene petersonii*	G2		No		11	No
P	Flowering Plants	Funeral Mountain Blue-eyed-grass	*Sisyrinchium funereum*	G2		No		3	No
P	Flowering Plants	Big-root Blue-eyed-grass	*Sisyrinchium radicatum*	G2		No		1	No
P	Flowering Plants	Nye County Smelowskia	*Smelowskia holmgrenii*	G2		No		18	Yes
P	Flowering Plants	Jone's Globemallow	*Sphaeralcea caespitosa*	G2		No		13	Yes
P	Flowering Plants	Ute Ladies'-tresses	*Spiranthes diluvialis*	G2	LT	Yes		18	Yes
P	Flowering Plants	Hooded Ladies'-tresses	*Spiranthes romanzoffiana*	G5		Yes		1	No
P	Flowering Plants		*Stipa shoshoneana*	G2		No		1	No
P	Flowering Plants	Alpine Jewelflower	*Streptanthus gracilis*	G3		No		3	No
P	Flowering Plants	Masonic Mountain Jewelflower	*Streptanthus oliganthus*	G2		No		32	Yes
P	Flowering Plants	Tiehm's Stroganowia	*Stroganowia tiehmii*	G2		No		43	Yes
P	Flowering Plants	Eureka Dunes Grass	*Swallenia alexandrae*	G1	LE	Yes		5	No
P	Flowering Plants	Welsh's American-aster	*Symphyotrichum welshii*	G2		No		5	No
P	Flowering Plants	Alpine Goldenweed	*Tonestus alpinus*	G2		No		11	Yes
P	Flowering Plants	Granite Haplopappus	*Tonestus graniticus*	G1		No		2	Yes
P	Flowering Plants	Dedecker's Clover	*Trifolium dedeckerae*	G2		No		13	Yes
P	Flowering Plants	Frisco Clover	*Trifolium friscanum*	G1		No		6	Yes
P	Flowering Plants	Leiberg's Clover	*Trifolium leibergii*	G2		No		13	No
P	Flowering Plants	Rollins Clover	*Trifolium rollinsii*	G2		No		13	Yes
P	Flowering Plants	Frank Smith's Violet	*Viola frank-smithii*	G1		No		31	No
P	Flowering Plants	Rock Violet	*Viola lithion*	G1		No		6	Yes
P	Mosses		*Bruchia bolanderi*	G3		No		1	No

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Mosses		*Orthotrichum shevockii*	G1		No		4	No
P	Mosses		*Orthotrichum spjutii*	G1		No		1	No
P	Mosses		*Pohlia tundrae*	G2		No		1	No

Appendix 4b. Master List of Candidate Species for the Central Basin and Range Ecoregion under criteria c-d.

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Amphibians	Canyon Treefrog	*Hyla arenicolor*	G5		No	AZ, CO, UT	3	No
A	Amphibians	Pacific Chorus Frog	*Pseudacris regilla*	G5		No	AZ, UT	53	No
A	Amphibians	Toiyabe spotted frog	*Rana luteiventris ssp.*	GNR		No			Yes
A	Amphibians	Northern leopard frog	*Rana pipiens ssp.*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena chrylismiae*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena nevadae*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena raveni*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena sp. Nov.*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena taeniata*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Andrena thorpi*	GNR		No			Yes
A	Ants, Wasps, and Bees	(BEE)	*ANTHIDIUM RODECKI*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Anthophora affabilis*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Anthophora sp. nov.*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Aphodius parapyriformis ssp. nov.*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Ashmeadiella rhodognatha*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Atoposmia panamintensis*	GNR		No			Yes
A	Ants, Wasps, and Bees	Red-legged beardtongue bee	*Atoposmia rufifemur*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Wasp)	*Bembix frommeri*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Calliopsis barri*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Calliopsis filiorum*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Calliopsis hesperia equina*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Calliopsis phaceliae*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Calliopsis sp. Nov*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Colletes ciliatoides*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Colletes sp. Nov. 1*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Colletes stepheni*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Colletes tectiventris*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Colletes xerophilus cismontanus*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Hesperapis kayella*	GNR		No			Yes
A	Ants, Wasps, and Bees	(BEE)	*HESPERAPIS OLIVIAE*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Hesperapis sp. nov.2*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Parasitic bee)	*Melecta alexanderi*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Osmia alpestris*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Osmia nigropilosa*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Osmia tanneri*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita arenaria*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita aridella*	GNR		No			Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Ants, Wasps, and Bees	(BEE)	*PERDITA BOHARTORUM*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita chloris*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita cleomellae*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita cowaniae*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita crotonis juabensis*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita eucnides eucnides*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita exigua*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita haigi*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita hirticeps apicata*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita leucostoma*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita mormonica*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita nasuta galacticoptera*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita sp. nov. 3*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita vesca*	GNR		No			Yes
A	Ants, Wasps, and Bees	(Bee)	*Perdita xerophila fuscicornis*	GNR		No			Yes
A	Birds	Boreal Owl	*Aegolius funereus*	G5		No	AK, CO, ID, MN, NM, UT, WA, WY	2	No
A	Birds	A Yellow Warbler	*Dendroica petechia brewsteri*	T3		No	CA	5	No
A	Butterflies and Skippers	Small Wood-Nymph	*Cercyonis oetus alkalorum*	T1		No		1	Yes
A	Butterflies and Skippers		*Cercyonis oetus pallescens*	T1		No		1	Yes
A	Butterflies and Skippers	Carson Valley Wood Nymph	*Cercyonis pegala carsonensis*	T2		No		14	Yes
A	Butterflies and Skippers	White River Wood Nymph	*Cercyonis pegala pluvialis*	T2		No		11	Yes
A	Butterflies and Skippers	Baking Powder Flat Blue	*Euphilotes bernardino minuta*	T1		No		4	Yes
A	Butterflies and Skippers	Dotted Blue	*Euphilotes enoptes aridorum*	T1		No		1	Yes
A	Butterflies and Skippers	Sand Mountain Blue	*Euphilotes pallescens arenamontana*	T1		No		2	Yes
A	Butterflies and Skippers	Mattoni's Blue	*Euphilotes pallescens mattonii*	T1		No		3	Yes
A	Butterflies and Skippers	Rice's Blue	*Euphilotes pallescens ricei*	T1		No			Yes
A	Butterflies and Skippers	Koret's Checkerspot	*Euphydryas editha koreti*	T3		No			Yes
A	Butterflies and Skippers	White Mountains Skipper	*Hesperia miriamae longaevicola*	T1		No		10	Yes
A	Butterflies and Skippers	Railroad Valley Skipper	*Hesperia uncas fulvapalla*	T1		No		4	Yes
A	Butterflies and Skippers	Railroad Valley Skipper	*Hesperia uncas giulianii*	T1		No			Yes
A	Butterflies and Skippers	Railroad Valley Skipper	*Hesperia uncas grandiosa*	T1		No		1	Yes
A	Butterflies and Skippers	Railroad Valley Skipper	*Hesperia uncas reeseorum*	T1		No			Yes
A	Butterflies and Skippers	Colorado Hairstreak	*Hypaurotis crysalus intermedia*	T1		No			Yes
A	Butterflies and Skippers	Nevada Viceroy	*Limenitis archippus lahontani*	T1		No		37	Yes
A	Butterflies and Skippers	White Mountains Copper	*Lycaena rubidus incana*	T1		No		1	Yes
A	Butterflies and Skippers		*Ochlodes yuma lutea*	TNR		No			Yes
A	Butterflies and Skippers	Steptoe valley crescentspot	*Phyciodes batesii arenacolor*	GNR		No			Yes
A	Butterflies and Skippers	Field Crescent	*Phyciodes pulchella shoshoni*	T2		No			Yes
A	Butterflies and Skippers	White Mountains Icarioides Blue	*Plebejus icarioides albihalos*	T2		No		10	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Butterflies and Skippers	White Mountain Skipper	*Polites sabuleti albamontana*	T2		No		3	Yes
A	Butterflies and Skippers		*Polites sabuleti basinensis*	T2		No		10	Yes
A	Butterflies and Skippers		*Polites sabuleti genoa*	T3		No		1	Yes
A	Butterflies and Skippers	Dark Sandhill Skipper	*Polites sabuleti nigrescens*	T3		No		18	Yes
A	Butterflies and Skippers	Eunus Skipper	*Pseudocopaeodes eunus flavus*	T3		No			Yes
A	Butterflies and Skippers	Mono Lake Wandering skipper	*Pseudocopaeodes eunus ssp. Nov*	GNR		No			Yes
A	Butterflies and Skippers	Hedgerow Hairstreak	*Satyrium saepium latalinea*	T3		No			Yes
A	Butterflies and Skippers		*Satyrium sylvinus megapallidum*	T3		No			Yes
A	Butterflies and Skippers	Grey's Frittilary	*Speyeria hesperis greyi*	T1		No			Yes
A	Butterflies and Skippers	Apache Fritillary	*Speyeria nokomis apacheana*	T2		No		8	Yes
A	Butterflies and Skippers	Carson Valley Silverspot	*Speyeria nokomis carsonensis*	T1		No		14	Yes
A	Dragonflies and Damselflies	Bleached Skimmer	*Libellula composita*	G3		No		8	No
A	Fairy, Clam, and Tadpole Shrimps	Giant Fairy Shrimp	*Branchinecta gigas*	G4		No			Yes
A	Freshwater Amphipods	(Aquatic amphipod)	*Stygobromus sp. Nov. (Owens Valley)*	GNR		No			Yes
A	Freshwater Amphipods	(Aquatic amphipod)	*Stygobromus sp. Nov. (Ruby Marsh)*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	Duckwater creek tui chub/ hot creek tui chub/ railroad valley tui chub	*Gila bicolor nevadae*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	Charnock Springs Tui Chub	*Gila bicolor ssp. 10*	T1		No		4	Yes
A	Freshwater and Anadromous Fishes	Dixie Valley Tui Chub	*Gila bicolor ssp. 9*	T1		No		2	Yes
A	Freshwater and Anadromous Fishes	Benton Valley speckled dace	*Rhinichthys osculus sp. bv*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	Long Valley speckled dace	*Rhinichthys osculus ssp.*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	Meadow valley speckled dace	*Rhinichthys osculus ssp. 2 mv*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	Owen's speckled dace	*Rhinichthys osculus ssp. 2 ow*	GNR		No			Yes
A	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*	T2		No		20	Yes
A	Freshwater Snails	Toquerville Springsnail	*Pyrgulopsis kolobensis*	G5		No		81	Yes
A	Grasshoppers	(GRASSHOPPER)	*TRIMEROTROPIS BARNAMI*	GNR		No			Yes
A	Katydids and Crickets	Sand obligate cricket	*Stenopelmatus ssp. Nov*	GNR		No			Yes
A	Mammals	Ringtail	*Bassariscus astutus*	G5		No	LA, NV, OK, OR	14	No
A	Mammals	Desert Pocket Mouse	*Chaetodipus penicillatus*	G5		No	NV	2	No
A	Mammals	Desert Kangaroo Rat	*Dipodomys deserti*	G5		No	NV, UT	8	Yes
A	Mammals	Chisel-toothed Kangaroo Rat	*Dipodomys microps*	G5		No		14	Yes
A	Mammals	Argus Mountains Kangaroo Rat	*Dipodomys panamintinus argusensis*	T2		No	CA	1	No
A	Mammals	Panamint Kangaroo Rat	*Dipodomys panamintinus panamintinus*	T3		No	CA	1	No
A	Mammals	Silver-haired Bat	*Lasionycteris noctivagans*	G5		No	AK, CA, CT, DE, IN, LA, MA, MD, MI,	29	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
							MS, NC, NH, NJ, NY, OR, PA, RI, VT, WI, WV, WY		
A	Mammals	Sagebrush Vole	*Lemmiscus curtatus*	G5		No	ND, NV, WA, WY		Yes
A	Mammals	Humboldt River otter	*Lutra canadensis nexa*	GNR		No			Yes
A	Mammals	Sierra Marten	*Martes americana sierrae*	T3		No	CA	20	No
A	Mammals	Owens Valley Vole	*Microtus californicus vallicola*	T1		No	CA	13	Yes
A	Mammals	Californian Myotis	*Myotis californicus*	G5		No	AK, AZ, OR, WA	15	No
A	Mammals	Western Small-footed Myotis	*Myotis ciliolabrum*	G5		No	CA, KS, ND, NV, WA, WY	67	No
A	Mammals	Long-eared Myotis	*Myotis evotis*	G5		No	CA, ND, WA, WY	53	No
A	Mammals	Little Brown Myotis	*Myotis lucifugus*	G5		No	AK, AL, CA, CT, IN, KS, MS, NV, RI, VT, WY	5	No
A	Mammals	Long-legged Myotis	*Myotis volans*	G5		No	AK, CA, ND, NE, OR, WA, WY	74	No
A	Mammals	Yuma Myotis	*Myotis yumanensis*	G5		No	CA, TX, UT, WA	25	No
A	Mammals	Yellow-pine Chipmunk	*Neotamias amoenus celeris*	T2		No	NV	1	No
A	Mammals	Cliff Chipmunk	*Neotamias dorsalis*	G5		No	ID, WY	1	No
A	Mammals	Crawford's Gray Shrew	*Notiosorex crawfordi*	G5		No	AR, OK, TX, UT	2	No
A	Mammals	White Mountains Pika	*Ochotona princeps sheltoni*	T1		No	CA	11	No
A	Mammals	Pika	*Ochotona princeps sspp.*	GNR		No			Yes
A	Mammals	Western Pipistrelle	*Parastrellus hesperus*	G5		No	AZ, WA	22	No
A	Mammals	Merriam's Shrew	*Sorex merriami*	G5		No	AZ, ID, NE, UT, WA	1	No
A	Mammals	Merriam's Shrew	*Sorex merriami leucogenys*	T5		No	NV	3	No
A	Mammals	Inyo Shrew	*Sorex tenellus*	G3		No	NV	3	Yes
A	Mammals	Trowbridge's Shrew	*Sorex trowbridgii*	G5		No	NV	2	No
A	Mammals	Rock Squirrel	*Spermophilus variegatus*	G5		No	ID	18	No
A	Mammals	American Badger	*Taxidea taxus*	G5		No	AR, CA, IL, IN, MN, OH, TX, WA	14	No
A	Mammals	Fish Spring Pocket Gopher	*Thomomys bottae abstrusus*	TH		No	NV	1	No
A	Mammals	San Antonio Pocket Gopher	*Thomomys bottae curtatus*	TH		No	NV	1	No
A	Mammals	Mountain Pocket Gopher	*Thomomys monticola*	G5		No	NV	1	No
A	Mammals	Western Jumping Mouse	*Zapus princeps*	G5		No	NV	2	No
A	Mayflies	A Mayfly	*Baetisca lacustris*	G5		No			Yes
A	Other Beetles	(Scarab beetle)	*Aegialia spinosa*	GNR		No			Yes
A	Other Beetles	(Click beetle)	*Cardiophorus spp.*	GNR		No			Yes
A	Other Beetles	(Click beetle)	*Cardiophorus ssp. Nov.*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Chilometopon pallidium*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Edrotes ventricosus*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Eusattus hirsutus*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Eusattus muricatus*	GNR		No			Yes
A	Other Beetles	Utah Hydroporus Diving Beetle	*Hydroporus utahensis*	GH		No		1	Yes
A	Other Beetles	(Sand obligate beetle)	*Lariversius tibalis*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Mecynotarsus delicatulus*	GNR		No			Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
A	Other Beetles	(Sand obligate beetle)	*Niptus ventriculus*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Novelsis sabulorum*	GNR		No			Yes
A	Other Beetles	(Predatory beetle)	*Philothris ssp. Nov.*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Rhadine myrmecodes*	GNR		No			Yes
A	Other Beetles	(Sand obligate beetle)	*Tetragonoderus pallidus*	GNR		No			Yes
A	Other Beetles	Mexican Cloudy Wing	*Thorybes mexicana blanca*	T2		No			Yes
A	Other Freshwater Crustaceans		*Potamocypris ssp. Nov*	GNR		No			Yes
A	Other Insects		*Dianthidium marshi*	GNR		No			Yes
A	Other Insects		*Dufourea orovada*	GNR		No			Yes
A	Other Insects	Hoplitis shoshone	*Hoplitis shoshone*	GNR		No			Yes
A	Other Insects		*Hydroscapha natans*	GNR		No			Yes
A	Other Insects		*Trogloderus costatus*	GNR		No			Yes
A	Reptiles	Northern Pacific Pond Turtle	*Actinemys marmorata marmorata*	T3		No	CA, NV, OR		Yes
A	Reptiles	Glossy Snake	*Arizona elegans*	G5		No	KS, NE, UT	13	No
A	Reptiles	Plateau Striped Whiptail	*Aspidoscelis velox*	G5		No	UT	7	No
A	Reptiles	Ring-necked Snake	*Diadophis punctatus*	G5		No	DC, ID, MI, UT, WA	29	No
A	Reptiles	Long-nosed Leopard Lizard	*Gambelia wislizenii*	G5		No	CO, NV, TX, UT	7	No
A	Reptiles	Common Kingsnake	*Lampropeltis getula*	G5		No	CO, DE, FL, IA, NE, OR, UT	12	No
A	Reptiles	Utah Mountain Kingsnake	*Lampropeltis pyromelana infralabialis*	T3		No	AZ		Yes
A	Reptiles	Milksnake	*Lampropeltis triangulum*	G5		No	DE, KS, LA, MN, MT, NM, SC, UT, WY	54	No
A	Reptiles	Coachwhip	*Masticophis flagellum*	G5		No	IL, MS, NC, NE, TN, UT	21	No
A	Reptiles	Short-horned Lizard	*Phrynosoma hernandesi*	G5		No	AZ, ND, NE, NV, SD, TX, WY		Yes
A	Reptiles	Long-nosed Snake	*Rhinocheilus lecontei*	G5		No	CO, ID, KS, OK, UT	16	No
A	Reptiles	Western Patch-nosed Snake	*Salvadora hexalepis*	G5		No	UT	7	No
A	Reptiles	Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*	T5		No	CA, OR	2	No
A	Reptiles	Groundsnake	*Sonora semiannulata*	G5		No	AR, ID, KS, UT	8	No
A	Reptiles	Smith's Black-headed Snake	*Tantilla hobartsmithi*	G5		No	AZ, CO, UT	9	No
A	Reptiles	Sonoran Lyresnake	*Trimorphodon lambda*	G5		No	NV	3	No
A	Stoneflies	A Stonefly	*Capnura intermontana*	G4		No			Yes
A	Stoneflies	A Stonefly	*Capnura wanica*	G5		No			Yes
A	Stoneflies	Autumn Springfly	*Pictetiella expansa*	G3		No		5	No
A	Stoneflies	A Giant Stonefly	*Pteronarcys princeps*	G4		No			Yes
A	Stoneflies	A Stonefly	*Utacapnia lemoniana*	G5		No			Yes
A	Stoneflies	A Stonefly	*Utaperla sopladora*	G4		No			Yes
A	Tiger Beetles	Ghost Tiger Beetle	*Cicindela lepida*	G3		No		1	No
A	Turtles	Western Pond Turtle	*Actinemys marmorata*	G3		No	CA, WA	10	No
P	Flowering Plants	Cusick's Giant-hyssop	*Agastache cusickii*	G3		No		7	Yes
P	Flowering Plants	Wheeler's Sandwort	*Arenaria congesta var. wheelerensis*	T2		No		6	Yes
P	Flowering Plants	One-leaflet Torrey Milkvetch	*Astragalus calycosus var. monophyllidius*	T2		No		7	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Cima Milkvetch	*Astragalus cimae var. cimae*	T2		No		3	Yes
P	Flowering Plants	Pine Valley Milkvetch	*Astragalus convallarius var. finitimus*	T3		No		3	Yes
P	Flowering Plants	Margaret's Rushy Milkvetch	*Astragalus convallarius var. margaretiae*	T2		No		11	Yes
P	Flowering Plants	Spinyleaf Milkvetch	*Astragalus kentrophyta var. elatus*	T4		No		8	Yes
P	Flowering Plants	Mottled Milk-vetch	*Astragalus lentiginosus var. kennedyi*	T3		No			Yes
P	Flowering Plants	Broad-pod Freckled Milkvetch	*Astragalus lentiginosus var. latus*	T2		No		9	Yes
P	Flowering Plants	Pohl's Milkvetch	*Astragalus lentiginosus var. pohlii*	T1		No		17	Yes
P	Flowering Plants	Charleston Milkvetch	*Astragalus oophorus var. clokeyanus*	T2		No		27	Yes
P	Flowering Plants	Lavin's Egg Milkvetch	*Astragalus oophorus var. lavinii*	T2		No		16	Yes
P	Flowering Plants	Pink Egg Milkvetch	*Astragalus oophorus var. lonchocalyx*	T2		No		17	Yes
P	Flowering Plants	Lahontan Milkvetch	*Astragalus porrectus*	G3		No		30	No
P	Flowering Plants	Lamoille Canyon Milkvetch	*Astragalus robbinsii var. occidentalis*	T2		No		38	Yes
P	Flowering Plants	Squalid Milkvetch	*Astragalus serenoi var. sordescens*	T2		No		13	Yes
P	Flowering Plants	Zion Milkvetch	*Astragalus zionis var. vigulus*	T1		No		6	Yes
P	Flowering Plants	Fourwing Saltbush	*Atriplex canescens var. gigantea*	T1		No		25	Yes
P	Flowering Plants	Intermountain Evening-primrose	*Camissonia megalantha*	G3		No		16	No
P	Flowering Plants	Clokey's Paintbrush	*Castilleja applegatei ssp. 1*	T3		No		9	Yes
P	Flowering Plants	Mt. Hamilton Indian-paintbrush	*Castilleja dissitiflora*	G4		No			Yes
P	Flowering Plants	Rough Indian-paintbrush	*Castilleja scabrida var. barnebyana*	T3		No			Yes
P	Flowering Plants	Hall's Meadow Hawk's-beard	*Crepis runcinata ssp. hallii*	T3		No		11	Yes
P	Flowering Plants	Bush-loving Cat's-eye	*Cryptantha dumetorum*	G3		No		2	No
P	Flowering Plants	Plains Wavewing	*Cymopterus acaulis var. parvus*	T2		No		17	Yes
P	Flowering Plants	Gilman Cymopterus	*Cymopterus gilmanii*	G3		No		18	No
P	Flowering Plants	Golf-ball Spring-parsley	*Cymopterus globosus*	G3		No		4	Yes
P	Flowering Plants	Cusick's Whitlow-grass	*Draba cusickii var. pedicellata*	T3		No			Yes
P	Flowering Plants	Subalpine Whitlow-grass	*Draba oreibata var. serpentina*	T1		No		4	Yes
P	Flowering Plants	Deer Goldenweed	*Ericameria cervina*	G3		No		12	Yes
P	Flowering Plants	Watson's Goldenweed	*Ericameria watsonii*	G3		No		22	No
P	Flowering Plants	Wasatch Daisy	*Erigeron arenarioides*	G3		No		37	Yes
P	Flowering Plants	Toiyabe Buckwheat	*Eriogonum esmeraldense var. toiyabense*	T2		No		13	Yes
P	Flowering Plants	Ruby Mountain Wild Buckwheat	*Eriogonum kingii*	G3		No			Yes
P	Flowering Plants	Lemmon's Buckwheat	*Eriogonum lemmonii*	G3		No		20	Yes
P	Flowering Plants	Panamint Mountains Buckwheat	*Eriogonum microthecum var. panamintense*	T2		No		4	Yes
P	Flowering Plants	Ostlund's Buckwheat	*Eriogonum ostlundii*	G3		No		4	No
P	Flowering Plants	Heavenly Buckwheat	*Eriogonum ovalifolium var. caelestinum*	T2		No		5	Yes
P	Flowering Plants	Downy Buckwheat	*Eriogonum puberulum*	G3		No		1	No
P	Flowering Plants	Churchill Narrows buckwheat	*Eriogonum sp.*	GNR		No			Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	Hot Springs Fimbry	*Fimbristylis thermalis*	G4		No		6	Yes
P	Flowering Plants	Pahute Green-gentian	*Frasera pahutensis*	G3		No		51	No
P	Flowering Plants	Cactus Flat Gily-flower	*Gilia heterostyla*	G3		No		4	Yes
P	Flowering Plants	Brickell's Hazardia	*Hazardia brickellioides*	G3		No		4	No
P	Flowering Plants	Sierra Valley Ivesia	*Ivesia aperta var. aperta*	T2		No		79	Yes
P	Flowering Plants	Rock Purpusia	*Ivesia arizonica var. saxosa*	T1		No		5	Yes
P	Flowering Plants	King's Ivesia	*Ivesia kingii var. kingii*	T2		No		15	Yes
P	Flowering Plants	Ostler's Ivesia	*Ivesia shockleyi var. ostleri*	T1		No		3	Yes
P	Flowering Plants	Cliff Jamesia	*Jamesia americana var. macrocalyx*	T2		No		46	Yes
P	Flowering Plants	Thickleaf Pepperwort	*Lepidium integrifolium var. heterophyllum*	T1		No		6	Yes
P	Flowering Plants	Arizona Bladderpod	*Lesquerella arizonica*	G3		No		2	No
P	Flowering Plants	Sand Linanthus	*Linanthus arenicola*	G3		No		1	No
P	Flowering Plants	Rough Desert-parsley	*Lomatium scabrum var. tripinnatum*	T2		No		13	Yes
P	Flowering Plants	Jaw-leaf Lupine	*Lupinus malacophyllus*	G3		No		1	Yes
P	Flowering Plants	Rayless Tansy-aster	*Machaeranthera grindelioides var. depressa*	T3		No		49	Yes
P	Flowering Plants	Candelaria Blazingstar	*Mentzelia candelariae*	G3		No		19	Yes
P	Flowering Plants	Parry's Monkeyflower	*Mimulus parryi*	G3		No		14	No
P	Flowering Plants	Watson's Oxytheca	*Oxytheca watsonii*	G3		No		10	Yes
P	Flowering Plants	Skunk-top Scurfpea	*Pediomelum mephiticum*	G3		No		12	Yes
P	Flowering Plants	Broadbeard Beardtongue	*Penstemon angustifolius var. dulcis*	T2		No		20	Yes
P	Flowering Plants	White River Valley Beardtongue	*Penstemon barnebyi*	G3		No		1	Yes
P	Flowering Plants	Gray Beardtongue	*Penstemon humilis ssp. Humilis*	T5		No			Yes
P	Flowering Plants	Charleston Beardtongue	*Penstemon leiophyllus var. francisci-pennellii*	T2		No		8	Yes
P	Flowering Plants	Dad's Beardtongue	*Penstemon leonardii var. patricus*	T2		No		18	Yes
P	Flowering Plants	Lahontan Beardtongue	*Penstemon palmeri var. macranthus*	T2		No		26	Yes
P	Flowering Plants	Ruby Mountain Beardtongue	*Penstemon procerus var. modestus*	T2		No			Yes
P	Flowering Plants	Barneby's Scorpionweed	*Phacelia barnebyana*	G3		No		3	No
P	Flowering Plants	Southwestern Phacelia	*Phacelia glaberrima*	G3		No		26	Yes
P	Flowering Plants	Western Phacelia	*Phacelia incana*	G3		No		1	No
P	Flowering Plants	Undescribed phacelia 1	*Phacelia sp. 1*	GNR		No			Yes
P	Flowering Plants	Marsh's Bluegrass	*Poa abbreviata ssp. marshii*	T2		No		2	Yes
P	Flowering Plants	Intermountain Milkwort	*Polygala intermontana*	G3		No		3	No
P	Flowering Plants	Pennsylvania Cinquefoil	*Potentilla pensylvanica var. paucijuga*	T1		No			Yes
P	Flowering Plants	Ravendale Skullcap	*Scutellaria holmgreniorum*	G3		No		24	No
P	Flowering Plants	Naked catchfly	*Silene nuda var. nuda*	GNR		No			Yes
P	Flowering Plants	Nuttall's False Sagebrush	*Sphaeromeria argentea*	G3		No		2	No
P	Flowering Plants	Four-part Horsebrush	*Tetradymia tetrameres*	G4		No		7	Yes

Animal or Plant	Taxonomic Group	Common Name	Scientific Name	Rounded Global Rank	Federal Status (ESA)	State Protective Listing	States Where Listed in SWAP	Number of Natural Heritage Locations	TNC Ecoregion Target List
P	Flowering Plants	King's Serpentweed	*Tonestus kingii var. barnebyana*	T1		No		26	Yes
P	Flowering Plants	Charleston Ground-daisy	*Townsendia jonesii var. tumulosa*	T3		No		2	Yes
P	Flowering Plants	Currant Summit Clover	*Trifolium andinum var. podocephalum*	T1		No		3	Yes
P	Flowering Plants	Bright Yellow Violet	*Viola aurea*	G3		No		7	No

Appendix 5. Terrestrial Coarse-Filter Conservation Elements with Potentially Nested Species of Concern for Central Basin and Range Ecoregion (n = 56) based on preliminary analysis of species location data.

Ecosystem	Taxonomic Group	Common Name	Scientific Name
Great Basin Pinyon-Juniper Woodland	Birds	Pinyon Jay	*Gymnorhinus cyanocephalus*
	Birds	American Robin	*Turdus migratorius*
	Birds	Virginia's Warbler	*Vermivora virginiae*
	Flowering Plants	Pine Valley Milkvetch	*Astragalus convallarius var. finitimus*
	Flowering Plants	Charleston Milkvetch	*Astragalus oophorus var. clokeyanus*
	Flowering Plants	Pink Egg Milkvetch	*Astragalus oophorus var. lonchocalyx*
	Flowering Plants	Wind-loving Buckwheat	*Eriogonum anemophilum*
	Flowering Plants	Tunnel Springs Beardtongue	*Penstemon concinnus*
	Flowering Plants	Pahute Mesa Beardtongue	*Penstemon pahutensis*
	Flowering Plants	Inconspicuous Scorpionweed	*Phacelia inconspicua*
	Flowering Plants	Masonic Mountain Jewelflower	*Streptanthus oliganthus*
	Terrestrial Snails	Eureka Mountainsnail	*Oreohelix eurekensis*
Great Basin Xeric Mixed Sagebrush Shrubland	Flowering Plants	Darrow's Buckwheat	*Eriogonum darrovii*
	Flowering Plants	Jaw-leaf Lupine	*Lupinus malacophyllus*
Inter-Mountain Basins Big Sagebrush Shrubland	Birds	Sage Sparrow	*Amphispiza belli*
	Birds	Turkey Vulture	*Cathartes aura*
	Birds	Pinyon Jay	*Gymnorhinus cyanocephalus*
	Birds	Sage Thrasher	*Oreoscoptes montanus*
	Birds	Brewer's Sparrow	*Spizella breweri*
	Birds	Sharp-tailed Grouse	*Tympanuchus phasianellus*
	Flowering Plants	Beatley's Milkvetch	*Astragalus beatleyae*
	Flowering Plants	Long Valley Milkvetch	*Astragalus johannis-howellii*
	Flowering Plants	Golf-ball Spring-parsley	*Cymopterus globosus*
	Flowering Plants	Webber Ivesia	*Ivesia webberi*
Inter-Mountain Basins Big Sagebrush Steppe	Birds	Franklin's Gull	*Leucophaeus pipixcan*
Inter-Mountain Basins Greasewood Flat	Flowering Plants	Ruby Valley Buckwheat	*Eriogonum argophyllum*
	Flowering Plants	Eastwood's Milkweed	*Asclepias eastwoodiana*

Ecosystem	Taxonomic Group	Common Name	Scientific Name
Inter-Mountain Basins Mixed Salt Desert Scrub	Flowering Plants	Callaway Milkvetch	*Astragalus callithrix*
	Flowering Plants	Tonopah Milkvetch	*Astragalus pseudiodanthus*
	Flowering Plants	Winged Milkvetch	*Astragalus pterocarpus*
	Flowering Plants	Nevada Evening-primrose	*Camissonia nevadensis*
	Flowering Plants	Barneby's Caulanthus	*Caulanthus barnebyi*
	Flowering Plants	Rush Skeletonweed	*Chondrilla juncea*
	Flowering Plants	Lemmon's Buckwheat	*Eriogonum lemmonii*
	Flowering Plants	Son's Buckwheat	*Eriogonum natum*
	Flowering Plants	Lahontan Basin Buckwheat	*Eriogonum rubricaule*
	Flowering Plants	Utah Sunflower	*Helianthus deserticola*
	Flowering Plants	Southwestern Pepper-grass	*Lepidium nanum*
	Flowering Plants	Candelaria Blazingstar	*Mentzelia candelariae*
	Flowering Plants	Sand Cholla	*Opuntia pulchella*
	Flowering Plants	Nevada Oryctes	*Oryctes nevadensis*
Inter-Mountain Basins Mixed Salt Desert Scrub (cont)	Flowering Plants	Watson's Oxytheca	*Oxytheca watsonii*
	Flowering Plants	Dune Beardtongue	*Penstemon arenarius*
	Flowering Plants	Soldier Meadows Cinquefoil	*Potentilla basaltica*
	Flowering Plants	King's Indigo-bush	*Psorothamnus kingii*
	Flowering Plants	Nye County Fish-hook Cactus	*Sclerocactus nyensis*
	Flowering Plants	Schlesser's Pincushion	*Sclerocactus schlesseri*
Inter-Mountain Basins Montane Sagebrush Steppe	Flowering Plants	Toiyabe Buckwheat	*Eriogonum esmeraldense var. toiyabense*
	Flowering Plants	Pine Nut Ivesia	*Ivesia pityocharis*
	Flowering Plants	Rollins Clover	*Trifolium rollinsii*
Inter-Mountain Basins Semi-Desert Grassland	Flowering Plants	Mud-flat Milkvetch	*Astragalus yoder-williamsii*
Mojave Mid-Elevation Mixed Desert Scrub	Flowering Plants	Cima Milkvetch	*Astragalus cimae var. cimae*
	Flowering Plants	July Gold	*Dedeckera eurekensis*
	Flowering Plants	Rough Desert-parsley	*Lomatium scabrum var. tripinnatum*
	Mammals	Desert Valley Kangaroo Mouse	*Microdipodops megacephalus albiventer*

Appendix 6. Aquatic Coarse-Filter Conservation Elements with Proposed Nested Species of Concern for Central Basin and Range Ecoregion (n = 134).

Ecological System	Taxonomic Group	Common Name	Scientific Name
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland/Stream	Freshwater and Anadromous Fishes	Desert Sucker	*Catostomus clarkii*
	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*
	Freshwater and Anadromous Fishes	Meadow Valley Wash Desert Sucker	*Catostomus clarkii ssp. 2*
	Freshwater and Anadromous Fishes	Cui-ui	*Chasmistes cujus*
	Freshwater and Anadromous Fishes	Little Fish Lake Valley Tui Chub	*Gila bicolor ssp. 6*
	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*
	Freshwater and Anadromous Fishes	Virgin Spinedace	*Lepidomeda mollispinis*
	Freshwater and Anadromous Fishes	Virgin River Spinedace	*Lepidomeda mollispinis mollispinis*
	Freshwater and Anadromous Fishes	Speckled Dace	*Rhinichthys osculus*
	Freshwater and Anadromous Fishes	Big Smokey Valley Speckled Dace	*Rhinichthys osculus lariversi*
	Freshwater and Anadromous Fishes	Independence Valley Speckled Dace	*Rhinichthys osculus lethoporus*
	Freshwater and Anadromous Fishes	Clover Valley Speckled Dace	*Rhinichthys osculus oligoporus*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater Mussels	California Floater	*Anodonta californiensis*
	Freshwater Mussels	Western Pearlshell	*Margaritifera falcata*
	Reptiles	Northern Pacific Pond Turtle	*Actinemys marmorata marmorata*
Great Basin Lake/Reservoir	Birds	Wilson's Phalarope	*Phalaropus tricolor*
	Fairy, Clam, and Tadpole Shrimps	Mono Lake Brine Shrimp	*Artemia monica*
	Freshwater and Anadromous Fishes	White River Desert Sucker	*Catostomus clarkii intermedius*
	Freshwater and Anadromous Fishes	Cui-ui	*Chasmistes cujus*
	Freshwater and Anadromous Fishes	Little Fish Lake Valley Tui Chub	*Gila bicolor ssp. 6*
	Freshwater and Anadromous Fishes	Railroad Valley Tui Chub	*Gila bicolor ssp. 7*

Ecological System	Taxonomic Group	Common Name	Scientific Name
	Freshwater and Anadromous Fishes	Bonytail	*Gila elegans*
	Freshwater Mussels	California Floater	*Anodonta californiensis*
	Reptiles	Northern Pacific Pond Turtle	*Actinemys marmorata marmorata*
Great Basin Springs and Seeps	Freshwater and Anadromous Fishes	Preston White River Springfish	*Crenichthys baileyi albivallis*
	Freshwater and Anadromous Fishes	Hiko White River Springfish	*Crenichthys baileyi grandis*
	Freshwater and Anadromous Fishes	Moorman White River Springfish	*Crenichthys baileyi thermophilus*
	Freshwater and Anadromous Fishes	Railroad Valley Springfish	*Crenichthys nevadae*
	Freshwater and Anadromous Fishes	Owens River Pupfish	*Cyprinodon radiosus*
	Freshwater and Anadromous Fishes	Pahrump Poolfish	*Empetrichthys latos latos*
	Freshwater and Anadromous Fishes	Desert Dace	*Eremichthys acros*
	Freshwater and Anadromous Fishes	Little Fish Lake Valley Tui Chub	*Gila bicolor ssp. 6*
	Freshwater and Anadromous Fishes	Railroad Valley Tui Chub	*Gila bicolor ssp. 7*
	Freshwater and Anadromous Fishes	Big Smokey Valley Speckled Dace	*Rhinichthys osculus lariversi*
	Freshwater and Anadromous Fishes	Independence Valley Speckled Dace	*Rhinichthys osculus lethoporus*
	Freshwater and Anadromous Fishes	Clover Valley Speckled Dace	*Rhinichthys osculus oligoporus*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater and Anadromous Fishes	White River Speckled Dace	*Rhinichthys osculus ssp. 7*
	Freshwater Snails	Steptoe Hydrobe	*Eremopyrgus eganensis*
	Freshwater Snails	Pyramid Lake Pebblesnail	*Fluminicola dalli*
	Freshwater Snails	Virginia Mountains Pebblesnail	*Fluminicola virginius*
	Freshwater Snails	Utah Physa	*Physa gyrina utahensis*
	Freshwater Snails	Cloaked Physa	*Physa megalochlamys*
	Freshwater Snails	Benton Valley Springsnail	*Pyrgulopsis aardahli*
	Freshwater Snails	Duckwater Pyrg	*Pyrgulopsis aloba*
	Freshwater Snails	Southern Duckwater	*Pyrgulopsis anatina*

Ecological System	Taxonomic Group	Common Name	Scientific Name
Great Basin Springs and Seeps		Pyrg	
	Freshwater Snails	Longitudinal Gland Pyrg	*Pyrgulopsis anguina*
	Freshwater Snails	Elongate Cain Spring Pyrg	*Pyrgulopsis augustae*
	Freshwater Snails	Pleasant Valley Pyrg	*Pyrgulopsis aurata*
	Freshwater Snails	Large Gland Carico Pyrg	*Pyrgulopsis basiglans*
	Freshwater Snails	Small Gland Carico Pyrg	*Pyrgulopsis bifurcata*
	Freshwater Snails	Flat Pyrg	*Pyrgulopsis breviloba*
	Freshwater Snails	Fly Ranch Pyrg	*Pyrgulopsis bruesi*
	Freshwater Snails	Smooth Glenwood Pyrg	*Pyrgulopsis chamberlini*
	Freshwater Snails	Transverse Gland Pyrg	*Pyrgulopsis cruciglans*
	Freshwater Snails	Dixie Valley Pyrg	*Pyrgulopsis dixensis*
	Freshwater Snails	Emigrant Pyrg	*Pyrgulopsis gracilis*
	Freshwater Snails	Hamlin Valley Pyrg	*Pyrgulopsis hamlinensis*
	Freshwater Snails	Upper Thousand Spring Pyrg	*Pyrgulopsis hovinghi*
	Freshwater Snails	Hubbs Pyrg	*Pyrgulopsis hubbsi*
	Freshwater Snails	Humboldt Pyrg	*Pyrgulopsis humboldtensis*
	Freshwater Snails	Carinate Glenwood Pyrg	*Pyrgulopsis inopinata*
	Freshwater Snails	Landyes Pyrg	*Pyrgulopsis landyei*
	Freshwater Snails	Butterfield Pyrg	*Pyrgulopsis lata*
	Freshwater Snails	Elko Pyrg	*Pyrgulopsis leporina*
	Freshwater Snails	Squat Mud Meadows Pyrg	*Pyrgulopsis limaria*
	Freshwater Snails	Lockes Pyrg	*Pyrgulopsis lockensis*
	Freshwater Snails	Long Valley Pyrg	*Pyrgulopsis longae*
	Freshwater Snails	Western Lahontan Pyrg	*Pyrgulopsis longiglans*
	Freshwater Snails	Hardy Pyrg	*Pyrgulopsis marcida*
	Freshwater Snails	Pahranagat Pebblesnail	*Pyrgulopsis merriami*
	Freshwater Snails	Northern Soldier Meadow Pyrg	*Pyrgulopsis militaris*
	Freshwater Snails	Twentyone Mile Pyrg	*Pyrgulopsis millenaria*
	Freshwater Snails	Camp Valley Pyrg	*Pyrgulopsis montana*

Ecological System	Taxonomic Group	Common Name	Scientific Name
Great Basin Springs and Seeps	Freshwater Snails	Neritiform Steptoe Ranch Pyrg	*Pyrgulopsis neritella*
	Freshwater Snails	Ninemile Pyrg	*Pyrgulopsis nonaria*
	Freshwater Snails	Elongate Mud Meadows Pyrg	*Pyrgulopsis notidicola*
	Freshwater Snails	Sub-globose Steptoe Ranch Pyrg	*Pyrgulopsis orbiculata*
	Freshwater Snails	Owens Valley Springsnail	*Pyrgulopsis owensensis*
	Freshwater Snails	Big Warm Spring Pyrg	*Pyrgulopsis papillata*
	Freshwater Snails	Bifid Duct Pyrg	*Pyrgulopsis peculiaris*
	Freshwater Snails	Antelope Valley Pyrg	*Pyrgulopsis pellita*
	Freshwater Snails	Fish Slough Springsnail	*Pyrgulopsis perturbata*
	Freshwater Snails	Ovate Cain Spring Pyrg	*Pyrgulopsis pictilis*
	Freshwater Snails	Flat-topped Steptoe Pyrg	*Pyrgulopsis planulata*
	Freshwater Snails	Sada's Pyrg	*Pyrgulopsis sadai*
	Freshwater Snails	White River Valley Pyrg	*Pyrgulopsis sathos*
	Freshwater Snails	Sub-globose Snake Pyrg	*Pyrgulopsis saxatilis*
	Freshwater Snails	Northern Steptoe Pyrg	*Pyrgulopsis serrata*
	Freshwater Snails	Sterile Basin Pyrg	*Pyrgulopsis sterilis*
	Freshwater Snails	Lake Valley Pyrg	*Pyrgulopsis sublata*
	Freshwater Snails	Southern Steptoe Pyrg	*Pyrgulopsis sulcata*
	Freshwater Snails	Southern Bonneville Pyrg	*Pyrgulopsis transversa*
	Freshwater Snails	Southern Soldier Meadow Pyrg	*Pyrgulopsis umbilicata*
	Freshwater Snails	Northwest Bonneville Pyrg	*Pyrgulopsis variegata*
	Freshwater Snails	Duckwater Warm Springs Pyrg	*Pyrgulopsis villacampae*
	Freshwater Snails	Wong's Springsnail	*Pyrgulopsis wongi*
	Freshwater Snails	Fat-whorled Pondsnail	*Stagnicola bonnevillensis*
	Freshwater Snails	Grated Tryonia	*Tryonia clathrata*
	Freshwater Snails	Monitor Tryonia	*Tryonia monitorae*
	Freshwater Snails	Desert Tryonia	*Tryonia porrecta*

Ecological System	Taxonomic Group	Common Name	Scientific Name
	Freshwater Snails	Desert Valvata	*Valvata utahensis*
Inter-Mountain Basins Playa	Fairy, Clam, and Tadpole Shrimps	Giant Fairy Shrimp	*Branchinecta gigas*
North American Arid West Emergent Marsh and Pond	Birds	Redhead	*Aythya americana*
	Birds	Wilson's Phalarope	*Phalaropus tricolor*
	Freshwater and Anadromous Fishes	Little Fish Lake Valley Tui Chub	*Gila bicolor ssp. 6*
Not Yet Attributed	Freshwater Amphipods	(Aquatic amphipod)	*Stygobromus sp. Nov. (Owens Valley)*
	Freshwater Amphipods	(Aquatic amphipod)	*Stygobromus sp. Nov. (Ruby Marsh)*
	Freshwater and Anadromous Fishes	Owens Sucker	*Catostomus fumeiventris*
	Freshwater and Anadromous Fishes	June Sucker	*Chasmistes liorus*
	Freshwater and Anadromous Fishes	Fish Creek Springs Tui Chub	*Gila bicolor euchila*
	Freshwater and Anadromous Fishes	Independence Valley Tui Chub	*Gila bicolor isolata*
	Freshwater and Anadromous Fishes	Newark Valley Tui Chub	*Gila bicolor newarkensis*
	Freshwater and Anadromous Fishes	Lahontan Creek Tui Chub	*Gila bicolor obesa*
	Freshwater and Anadromous Fishes	Owens Tui Chub	*Gila bicolor snyderi*
	Freshwater and Anadromous Fishes	Fish Lake Valley Tui Chub	*Gila bicolor ssp. 4*
	Freshwater and Anadromous Fishes	Hot Creek Valley Tui Chub	*Gila bicolor ssp. 5*
	Freshwater and Anadromous Fishes	Big Smokey Valley Tui Chub	*Gila bicolor ssp. 8*
	Freshwater and Anadromous Fishes	Least Chub	*Iotichthys phlegethontis*
	Freshwater and Anadromous Fishes	White River Spinedace	*Lepidomeda albivallis*
	Freshwater and Anadromous Fishes	Southern Leatherside Chub	*Lepidomeda aliciae*
	Freshwater and Anadromous Fishes	Northern Leatherside Chub	*Lepidomeda copei*
	Freshwater and Anadromous Fishes	Big Spring Spinedace	*Lepidomeda mollispinis pratensis*
	Freshwater and Anadromous Fishes	Lahontan Cutthroat Trout	*Oncorhynchus clarkii henshawi*
	Freshwater and Anadromous Fishes	Paiute Cutthroat Trout	*Oncorhynchus clarkii seleniris*
	Freshwater and Anadromous Fishes	Bonneville Cutthroat Trout	*Oncorhynchus clarkii utah*

Ecological System	Taxonomic Group	Common Name	Scientific Name
Not Yet Attributed	Freshwater and Anadromous Fishes	Inland Redband Trout and Redband Steelhead	*Oncorhynchus mykiss gairdneri*
	Freshwater and Anadromous Fishes	Relict Dace	*Relictus solitarius*
	Other Freshwater Crustaceans		*Potamocypris ssp. Nov*
	Stoneflies	A Stonefly	*Capnia hornigi*
	Stoneflies	A Stonefly	*Utaperla sopladora*